THURSDAY, NOVEMBER 25, 1886

EXPLORATION OF THE NORTH SEA

Die Ergebnisse der Untersuchungsfahrten S.M.Knbt. "Drache" (Kommandant Korvetten-Kapitän Holzhauer) in der Nordsee in den Sommern 1881, 1882, *und* 1884. Veröffentlicht von dem Hydrographischen Amt der Admiralität. (Berlin: Ernst Siegfried Mittler und Sohn, 1886.)

OUR knowledge of the physical conditions of the North Sea has just been enriched by the publication of the results of the expeditions of the Prussian ship *Drache* during the summer months of the years 1881, 1882, and 1884. The expeditions and the publication have been carried out under the direction and with the authority of the Hydrographic Office of the German Admiralty.

Prof. Möbius, who has examined the organisms collected by the *Drache*, reports that he has found nothing worthy of special mention among the biological collections. It is otherwise with the physical and chemical observations, for the whole of the volume before us is devoted to these observations, their analysis and discussion. The publication is accompanied by synoptic tables showing the positions of the observing stations and the scientific results, as well as by fourteen charts setting forth graphically the currents, the depths, the salinity, specific gravity, and the quantity of oxygen in the surface, intermediate, and bottom water, and sections illustrating the distribution of temperature.

The temperature and salinity are first examined. The observations confirm the view that the salt heavy water of the Atlantic enters the North Sea by the north of Scotland, and, on being cooled, sinks to the bottom, and fills all the deeper parts of the basin, including the Norwegian Gut. The observations of the Norwegians and those on board the *Triton* showed that, in like manner, the deep water of the Norwegian Sea was largely made up of the salt Atlantic water, which sank to the bottom on reaching a colder latitude—probably mixing much with deep colder Polar and fresher water. The *Drache* traced this salt Atlantic water to the centre of the North Sea. It would be a matter of very great interest to have the temperature of the water taken at stated intervals throughout the year in the Norwegian Gut, in a similar manner to the observations now being carried on in the deep lochs of the west of Scotland. The observations on the currents of fresher water running to the north along the coasts of Britain and Jutland—the latter eventually meeting and mixing with that of the Baltic—are very interesting. Indeed, the extensive current and tidal observations are valuable additions to knowledge; but, as the author remarks, both they and the temperature observations are incomplete, being confined to the summer months, and he indicates the regions where observations are much required. Still, combined with the winter observations which we possess at certain points, the *Drache's* observations greatly augment our knowledge of the physical conditions of the North Sea, and of the modifying influences produced by the seasons.

The chemical work has been intrusted to Dr. Neumeister, under the direction of Prof. Jacobsen, and the geological part is by Dr. Gümbel. The chemical work includes the determination of the oxygen and nitrogen in water from different depths. Dr. Neumeister found in surface-water (mean of twenty-five analyses) the oxygen to be 33·95 per cent., the volume of the sum of the oxygen and nitrogen equalling 100. In deep water (200 metres) the oxygen descended to 25·20 per cent. of the volume of the two gases.

For carbonic acid combined as neutral salts, he found for surface-waters 52·66 milligrammes per litre (mean of sixty-seven determinations); the partially combined acid was found to be 43·78 milligrammes (mean of thirty-nine determinations).

As appendix to these researches, the results are given of the determinations of the carbonic acid in the waters of the Atlantic, Indian, and Pacific Oceans, collected by the *Gazelle* in 1874-76. The carbonic acid combined as neutral salts in the surface-waters reaches to 52·5 milligrammes per litre (mean of thirty-one observations). At 183 metres of depth, the mean is 53·2. For greater depths, down to 5000 metres, fourteen determinations gave 50·6 to 56·8 milligrammes. Four determinations gave 59 to 70 milligrammes, and one gave 82·7 milligrammes. No attempt is made to compare these with the *Challenger* results.

The author explains the presence of the large quantity of carbonic acid in deep water by the fact that the water dissolves the carbonate of lime, which is found in great quantity on the bottom in all moderate depths. The carbonic acid which effects this dissolution is probably furnished by the oxidation of organic substances. The author refers to the fact that carbonic acid is not necessary in order that carbonate of lime may be dissolved by sea-water, and has, in this respect, confirmed Dittmar's observations. Different waters, however, comport themselves very differently in this respect. The water of great rivers, adds the writer, at their embouchure contains less acid combined as neutral salts than ocean water, and the mixture of salt and river water, along coasts, less carbonic acid than the water in the great oceans; but the difference is not in proportion to the quantity of salts present. It is shown by analyses of Baltic water that while this water contains only about one-half of the salts present in pure ocean water, it contains nearly nine-tenths of the carbonic acid present in the neutral salts of pure ocean water.

Gümbel's work consists in an examination of the deposits collected from depths ranging from 18 to 317 metres. The forty samples, of which an excellent description is given, all belong to littoral, sub-littoral, or terrigenous deposits. None of them present the essential characters of truly deep-sea or pelagic sediments. The author divides them into quartz sands and sandy clays, the latter being of a much darker colour than the former. Gümbel has followed in his descriptions the methods indicated in the preliminary notices of the *Challenger* deposits. Gümbel attributes the absence of Globigerina ooze from the samples to the relatively shallow depths from which they were procured, and he adds that the depth determines the nature of the deposit. This is quite a mistake: it is, rather, distance from land that determines the kind of deposit. Deposits not unlike those

described by Gümbel occur in depths of over 2000 fathoms when near to land, while a Globigerina ooze or Pteropod ooze may occur in very shallow depths, in the tropics, far from land. These deposits of the *Drache*, being near the coast, it is found that quartz predominates. The fragments of plagioclase, orthose, hornblende, augite, bronzite, mica, garnet, tourmaline, dicroite (is it not glaucophane?), magnetite, zircon, chlorite, all come from the disintegration of the ancient rocks which form the coast of Norway and Scotland. Gümbel also finds fragments of granitic rocks, dioritic rocks, &c. Fragments of modern volcanic rocks, such as lavas and pumice, are very rare when compared with the particles derived from ancient rocks. Glauconite was found in some of the specimens, and the author believes that these have been transported, which is quite unlikely, as large deposits of glauconite are now in process of formation along the coasts of the north of Scotland. The organisms—mollusks, echinoderms, foraminifera, and diatoms—are all the same as those usually found in partially inclosed seas like the North Sea, and do not present any peculiarities worthy of note.

The author supposes that there is a continuation under the North Sea of the ancient rock-masses of Scandinavia. This may be true, but the supposition can in no way have been suggested by the chemical, microscopic, and mineralogical examinations of the deposits of the North Sea. In conclusion, Gümbel states that the sediments of the North Sea prove that sandy deposits can be formed alongside of clayey and marly deposits, during the same time in the same sea. This conclusion has already been perfectly established, and this confirmation supports an interpretation generally received, which was one of the first results of the examination of the *Challenger* deposits.

The Hydrographic Office of the German Admiralty have done excellent service in taking up the scientific examination of the North Sea. It is a work that we would like to see continued and advanced by our own Hydrographic Office. J. M.

OUR BOOK SHELF

Chemical Arithmetic. By Sydney Lupton, M.A., F.C.S., F.I.C. Second Edition. (London: Macmillan and Co., 1886.)

WE are pleased to note a new edition of this excellent work, in which several improvements have been made. The hundred pages of introductory matter in the first edition have been reduced by about one-half, much unnecessary pure arithmetic having been cut out. The 1200 examples with answers are, on the whole, well selected, though many of them can scarcely be called chemical. A greater number of typical examples might advantageously have been worked out at full length.

The book is especially to be commended for its clear and concise definitions, which are in many books very loosely expressed. The differences between density and specific gravity, atomic and molecular weights, for instance, are explained in a manner that any student of ordinary ability will readily understand. We feel sure that the book will be appreciated alike by students and teachers, but it will be especially valuable to teachers.

Experimental Chemistry. By C. W. Heaton, F.I.C., F.C.S. New Edition, Revised. (London: George Bell and Sons, 1886.)

ANOTHER edition of this work on experimental chemistry, adapted from the German of Dr. Stöckhardt, has just been issued. To those students of limited means who desire to work at chemistry as well as to read it—and it is for those that the book is intended—it will be found useful. The introduction, however, is much too extensive and theoretical for beginners, and we fear that many would be disheartened before reaching the really experimental work. In our opinion, the book is not sufficiently practical, many experiments lacking detail. We would suggest that in future editions a few pages be devoted to instructions in the manipulation of apparatus and the working of glass.

Part IV., which is devoted to organic chemistry, is very clearly set out. The book is not sufficiently modernised for these days of competitive examinations, but the teacher who is desirous of encouraging his students to perform simple experiments in spare moments would get many valuable ideas from it.

LETTERS TO THE EDITOR

[The Editor does not hold himself responsible for opinions expressed by his correspondents. Neither can he undertake to return, or to correspond with the writers of, rejected manuscripts. No notice is taken of anonymous communications.

[The Editor urgently requests correspondents to keep their letters as short as possible. The pressure on his space is so great that it is impossible otherwise to insure the appearance even of communications containing interesting and novel facts.]

The Sense of Smell

IN your issue of Septhmber 30 (vol. xxxiv. p. 521) your correspondent Dr. Arthur Mitchell is desirous of obtaining some data in regard to the sense of smell. In a paper presented at the Philadelphia meeting of the American Association for the Advancement of Science (1884) we have described a series of experiments designed to test the delicacy of this sense. These experiments, being of a preliminary character, have hitherto been withheld from publication, but the following brief statement of the results obtained may be of interest to Mr. Mitchell and to other readers of NATURE. We made use of the following substances:—(1) oil of cloves, (2) nitrite of amyl, (3) extract of garlic, (4) bromine, (5) cyanide of potassium. A series of solutions of each of these was prepared, such that each member was of half the strength of the preceding one. These series were extended by successive dilutions till it was impossible to detect the substances by smell. The order of the bottles containing these solutions was completely disarranged, and the test consisted in the attempt to properly classify them by the unaided sense of smell. The thirty-four observers who assisted in these experiments were of both sexes; the results are indicated in the following table (I.):—

Amount detected

	Oil of cloves	Nitrite of amyl	Extract of garlic	Bromine	Cyanide of potassium
Average of 17 males	1 part in 88,218 of water	1 in 783,870	1 in 57,927	1 in 49,254	1 in 109,140
Average of 17 females	1 part in 50,667 of water	1 in 311,330	1 in 43.900	1 in 16,244	1 in 9,002

The same method of investigation has since been followed by one of us[1] in some experiments, the results of which are given in Table II.

Amount detected

	Prussic acid	Oil of lemon	Oil of wintergreen
Average of 27 males	1 part in 112,000 of water	1 in 280,000	1 in 600,000
Average of 21 females	1 part in 18,000 of water	1 in 116,000	1 in 311,000

[1] "Some Special Tests in Regard to the Delicacy of the Sense of Smell," by E. H. S. Bailey and L. M. Powell (*Proc. Kansas Acad. o Science*, vol. ix.).

Many striking individual peculiarities were noticed in the course of the experiments, which these general averages fail to show. Three of the male observers were able to detect one part of prussic acid in about 2,000,000 parts of water. Two of these were persons engaged in occupations favouring the cultivation of this sense. Careful chemical tests failed to show the presence of prussic acid in several of the more dilute solutions, in which it could be detected by the sense of smell. We found some of both sexes who absolutely could not detect prussic acid even in solutions of almost overpowering strength. There were several instances of the same peculiarity as regards bromine. Again, our averages show that the sense of smell is in general much more delicate in the case of male than of female observers.

EDWARD L. NICHOLS
E. H. S. BAILEY

University of Kansas, November 4

Tidal Friction and the Evolution of a Satellite

ADVERTING to the correspondence in NATURE (vol. xxxiv. p. 286), I think that Mr. Darwin has not, so far, fully realised the results that would follow from the circumstance that the Martian satellite's period would be affected many hundred times more than that of the planet's rotation, as explained in the correspondence referred to. He argues that, the moon's mass being great, she should recede to an enormous distance before there will be a reversal of the direction of her tides on the earth; while the satellite of Mars, being very small, need only to recede a short distance before a similar tidal reversal ensues. No mention being made of any other supposed difference in the systems at the starting-point, it must be inferred that other things are supposed about equal. But, as a matter of fact, the present position of the Martian satellite is incompatible with an initial rotation of its planet anything like so great as that ascribed to the earth at a like stage. If Mars be supposed to rotate ten times while the satellite, at its present distance, makes nine revolutions, the satellite's period would still be affected or lengthened much more than would that of the planet's rotation. The difference between the periods of revolution of the planet and satellite would increase quickly at first, but more slowly as the satellite receded a certain distance, till at a certain time there would be no increase, after which there would be a decrease, and finally a reversal. When the satellite would have receded to a short distance, where she would revolve in the same period as Mars now rotates in, the planet would have lost but little of its original rapid rotation. Now, supposing the satellite tide to go round in the same time as the solar one, the period of the satellite would be affected about thirty times as much as that of the planet's rotation. Allowance being made for the comparative slowness of the satellite's tides, the satellite's period would still be changed more than ten times as much as that of the planet. It would be only when the little body got further out, and the planet's rotation slower than it now is, that there could be a reversal of the direction of the satellite's tides. Wherever started, the satellite must either go directly into the planet, or go out a short distance and back into the planet, before the rotation-period can have been much changed by solar tides; or else the satellite must go far out—as when it gets a fair start—and could not possibly turn back until the rotation of Mars be slower than now. Hence it seems that under no conditions could the rotation of Mars, at the birth of her moon, have been twice as rapid as now, and the evidence is very strong that the rotation-period could not have been changed more than a very few hours, if so much. Then, if the rotation of Mars was so slow in the beginning, and so little changed during the whole existence of the satellite, the circumstance does not support the view that the earth's rotation was very rapid in the beginning and so much changed during her past history, but rather inclines the other way.

Respecting the statement that two heavenly bodies cannot revolve about their centre of inertia as parts of a rigid body with their surfaces nearly in contact, unless one be smaller and denser than the other by a certain amount, I can only say, at the present time, that such was the conclusion at which I arrived when investigating the results of the tidal effects of two bodies on one another at close quarters. Without going far into the question, it can be seen that if the rule holds when the two bodies are of the same size and density, it will hold throughout. There will be no difficulty in seeing that the rule holds so far that when the difference in size between the bodies is as great as between any of the satellites and its primary, the small body must be invariably the denser. Now the argument that was supposed to apply in general would at least apply in the case of the solar system. That argument, as explained in my pamphlet, was that, if a rapidly-rotating body were to separate into two, the small body given off must be denser than the other to withstand the tidal disturbance, and that it would be impossible for the small body to be denser than the primary, since the secondary body must be formed from the surface and therefore lightest part of the other body.

JAMES NOLAN

Dergholm, Victoria, October 5

Seismometry in Japan

I HAVE read, with no small surprise, a paragraph in NATURE of November 11 (p. 36), giving a summary of a letter from Prof. John Milne, with reference to an article by me on the seismographs now manufactured by the Cambridge Scientific Instrument Company. Prof. Milne is represented as saying that, "with the exception of one or two which have been modified, a set of instruments like those recommended by Prof. Ewing are, so far as Japan is concerned, quite obsolete." His letter is not published, and it is possible that the paragraph inadvertently does him an injustice in making him assert what has absolutely no foundation in fact.

In any case the statement cannot be allowed to pass without contradiction. My seismographs have been in regular use at the University of Tokio since they were invented; they are now used for systematic observations by the Japanese Meteorological Bureau; they were sent last year by the Japanese Government to the Inventions Exhibition in London, where they were awarded the highest diploma among Government exhibits: one of them, the comparatively cheap and simple duplex pendulum seismograph, is employed by many private observers in Japan. In a letter received only a few weeks ago, my friend and former assistant, Mr. Sekiya, now Professor of Seismology in the University, says:—

"We are going to start a journal called the *Journal of the Science College of the Imperial University, Japan*. In the first number I will give a paper on 'Comparison of Earthquake Diagrams simultaneously obtained at the same station by two instruments involving the same principle, and thereby proving the trustworthiness of these instruments.' Of course I treat those diagrams recently obtained by two of your seismographs."

Other letters from Prof. Sekiya are full of accounts of the excellent work he is doing with these instruments, and of their continued and extended usefulness in his very able hands. A paper lately received from him describes a rough but effective form of the duplex pendulum, cheaply made in order to bring it within the reach of private observers, and with reference to this the *Japan Mail* of February 2, 1886, says:—

"The duplex pendulum seismograph designed by Prof. J. A. Ewing, has been employed for earthquake observations in the Tokio Daigaku by Mr. S. K. Sekiya, who has improved many of its details during his long use of the instrument. On account of the simplicity and scientific nature of its construction, and its easy management, it has found its way into the hands of many observers."

The *Mail* goes on to mention the name of a native firm by whom the instrument is made and sold. In March last Mr. Sekiya writes:—"The duplex pendulum sells well; some fifteen or twenty of them have been sold."

So much for the duplex pendulum seismograph, which is one of those described in my article, and now made with the utmost refinement of construction by the Cambridge Company. The other is a three-component instrument, of which the principal part is the horizontal pendulum seismograph—consisting of a pair of horizontal pendulums for recording separately two rectangular components of the horizontal motion of the ground on a moving surface driven by clockwork. This method of recording earthquakes was introduced by me in 1880 (*Trans. Seis. Soc. Jap.*, 1880; *Proc. Roy. Soc.*, No. 210), and has been in regular use ever since. The instruments made to my designs by native workmen are still doing good service in Prof. Sekiya's hands. Those now made by the Cambridge Company have the advantage of better workmanship and an improved arrangement of parts. As Prof. Sekiya has recently written to me with regard to the purchase of a set of them by the Japanese Government, it is probable that Mr. Milne will before long have

an opportunity of seeing the latest forms of the instruments in Japan.

No one knows better than Prof. Milne that the horizontal pendulum seismograph is not obsolete. He adopted it himself soon after I introduced it, and he has used it freely in his own investigations. His letter will be understood to mean that since I left Japan in 1883 there has been a new departure in seismometric methods which has made my apparatus fall out of date. There has been nothing of the kind. Can Mr. Milne point to any methods involving novel features of importance, and say what their novel features are? It would be odd for instruments to become obsolete when they answer their purpose very well, and when there is nothing better to take their place.

J. A. EWING

University College, Dundee, November 13

Ozone Papers in Towns

I TAKE the opportunity of mentioning that I have experimented with Moffatt's ozone papers in London for the past month, and find that on exposing the papers already previously coloured they all become bleached to their original white. They were previously exposed to the air at Brighton and Hastings, on the sea-coast, and were then coloured, and afterwards preserved closely shut up for trial in the mephitic air of towns.

Some more stained papers were also received from Cheltenham, which also became blanched on open-air exposure in London, though as highly stained as 8 degrees. They were not washed by rain, but kept dry in the usual cage in the open air and out of the sun; and they were of various shades of colour, from 2 to 8, as already marked on them. I should like to know or ask for opinion as to the chemical changes that had taken place, and if these had been due to an antozone causing a recomposition of the ingredients (starch and iodide potassium) to their original constitution. It may be likely, therefore, that in Moffatt's papers, coloured previously, we may have the means of testing the impure condition of the air of any locality by exposing them in it for a few hours.

Other papers had already been prepared for testing the sulphurous impregnation of the town air, as by compounds of lead, tin, &c.; but, though they became stained in the laboratory, yet they failed on trial in the open air. As to the influence of the wind, the quickest effect seemed to be produced by easterly winds, while those from the south-westerly direction were slower in action on the papers; but this, I think, may be merely due to the air from the east in London blowing first over a greater expanse of city, carrying with it adulterating emanations.

W. J. BLACK

London, November

The Similarities in the Physical Geography of the Great Oceans

IN the abstract of my paper read at the Royal Geographical Society on the 8th inst., which was published in NATURE of Nov. 11, there is a statement (p. 34) that the weight of the column of water between 20 fathoms and 70 fathoms from the surface under the westerly equatorial current is only 88 per cent. of the weight of the same column under the easterly counter equatorial current. I regret that a serious arithmetical error occurs in the calculations on which this statement was founded. There is no such considerable difference of weight in the two columns of water.

J. Y. BUCHANAN

Edinburgh, November 22

Lung Sick

DR. E. J. DUNGATE, with compliments to the Editor of NATURE, begs to inclose him a letter which he has just received from Prof. Smets, of Hasselt. It refers to the letter on "lung sick," which appeared in NATURE for November 11 (p. 29), and contains most important evidence on the subject. Dr. Dungate is sure, from the genial tone of the letter, that the Editor of NATURE is at liberty to publish it, if he desires.

6, Marchmont Road, Edinburgh, November 17

Hasselt (Belgique), le 14 Novembre, 1886

MONSIEUR DUNGATE,—J'ai lu votre demande dans la NATURE du 11 Novembre.

L'inoculation préventive de la pleuropneumonie exsudative a commencé à Hasselt, et la méthode, suivie déjà chez les Zoulous, a été préconisée, en premier lieu, par un médecin de Hasselt, M. le Dr. Willems. Je vous communiquerai, avec plaisir, ses travaux si vous les désirez.

On a essayé, à diverses reprises, à Hasselt, les inoculations au fanon, à la poitrine, etc.; elles ont eu des conséquences mortelles.

Je crois que cette pratique permettait au microbe d'envahir rapidement les poumons, et d'étouffer le bœuf. Mais quand on pratique l'inoculation à la queue, le microbe a passé par les divers stades de son existence, et est déjà à son déclin avant d'arriver au poumon. Il est possible aussi que le microbe, que je crois fortement aérobie, a été atténué dans sa virulence par suite de son passage dans des organes où l'oxygène est plus rare

Plusieurs fois, néanmoins, l'inoculation est encore mortelle, en moyenne 1 cas sur 100 inoculations à Hasselt.

La perte de la queue est due, à mon avis, à ce que l'on fait usage d'un virus impur, obtenu empiriquement, sans culture. La gangrène, qui emporte une partie de la queue, peut être causée par un autre organisme inoculé simultanément avec le microbe de la maladie. Car, parfois, plusieurs bêtes inoculées en même temps, avec le même virus, ne perdent pas la partie inférieure de la queue, tandis que d'autres fois cet accident est fréquent. On prévient partiellement cet accident en faisant des incisions longitudinales dans l'engorgement qui se produit.

Agréez, Monsieur Dungate, l'expression de ma considération distinguée et de mon entier dévouement.

DR. GÉRARD SMETS,
Professeur à Hasselt (Belgique)

Meteor

PASSING along Kensington Gore yesterday at 7.20 p.m., I saw the finest meteor I have ever seen in my life. It descended from near the zenith perpendicularly through the constellation of the Great Bear. It was much larger than any planet. About half-way on its downward course it gave out a second meteor of a red colour, being itself of a pale yellow. The atmosphere was rather foggy at the time, but I could see the stars through the mist. It was, no doubt, the same meteor as is mentioned in to-day's *Times* as having been seen at Reading.

P. L. SCLATER

3, Hanover Square, London, W., November 18

The Origin of Species

MR. CATCHPOOL, writing in NATURE (vol. xxxiv. p. 617) on this subject, says:—"If B is separated from A by being nearly infertile, and C from B in the same way, C is likely to be still more infertile with A." This is quite a mistake. Suppose B to be the cat species, and A and C two varieties of dogs; A and C are quite fertile with each other, and infertile with B.

It is certain that mutual infertility is not caused by mere visible unlikeness. The horse and the ass, which do not produce fertile offspring, are much less visibly unlike than many of the varieties of dogs or of pigeons, which are mutually quite fertile.

May not mutual infertility be a result of long-continued separation, quite independently of any unlikeness arising? I do not know whether this conjecture is supported by any observations on the mutual relations of kindred species or varieties in lands separated by oceans.

JOSEPH JOHN MURPHY

Belfast, November 8

MR. MURPHY has mistaken my meaning, which I will try to make clear by an example. Suppose one brood of an ancient species of Gallinæ to have exhibited, as a sport, a partial infertility with the rest of the species, while the birds composing the brood remained abundantly fertile among themselves. Suppose the main body of that species to have become, by natural selection, our pheasants, while the isolated brood became the ancestors of our grouse. Suppose one brood of these grouse to have become partially infertile with the main body of grouse, and to have been the ancestors of our red grouse, while the main body of the grouse became, by natural selection, our black grouse. If, as I believe, variation does not produce or increase infertility, the black grouse will still be only partially infertile with the pheasant, and the red only partially infertile with the black grouse; but it seems probable, *primâ facie*, that the second spontaneous infertility would remove the red grouse

further from the pheasant, so that these would be quite infertile. But this is merely argument from analogy; there is no evidence of the result of such superposed "sports," and retrogression to greater fertility seems possible.

This instance is not a good one, because the observed partial infertility (*i.e.* only occasional fertility) between pheasant and black grouse may be due to dislike, not partial impotence. But I doubt whether distaste for pairing and impotence when paired are often quite dissociated.

Mr. Murphy asks, as I asked in these pages in 1884, and others have asked since, for one simple fact which would be decisive. Is it, or is it not, the fact that allied species which are confined each to a particular island, prove, when brought together, far less frequently infertile than species, equally dissimilar, which had lived in the same district, might be expected to prove. On the answer to this question depends, as far as I can see, the fate of the theory of physiological selection. Can no one answer it?

EDMUND CATCHPOOL

THE CORAL REEFS OF THE SOLOMON ISLANDS[1]

OUT of a collection of nearly seventy corals which I made in these islands, nearly a quarter are new or undescribed; and from this fact, as I am informed by Mr. S. Ridley, it may be inferred that there is yet much to be learned of the corals of this region. After describing in my paper the characters of a typical reef, I proceeded to refer to the complex relations that exist between the multitudes of creatures that frequent coral reefs. The protective colouring of the small crabs that live among the branching corals often attracted my attention. I recall, in particular, the instance of a small crab that finds its home among the branches of a *Pocillopora.* The light purple colour of its carapace corresponds with the hue of the coral at the base of the branches, where it lives; whilst the light red colour of the big claws, as they are held up in their usual attitude, similarly imitates the colour of the branches. To make the guise more complete, both carapace and claws possess rude hexagonal markings, which correspond exactly in size and appearance with the polyp-cells of the coral. Another species of crab, that climbs about the blue-tipped branches of a *Madrepora,* has the points of its pincer-claws similarly coloured. It is interesting to note that these two crabs are adapted to live each on its own species of coral. Had I caused them to exchange their homes, their borrowed hues and markings would have at once made them conspicuous objects for their enemies.

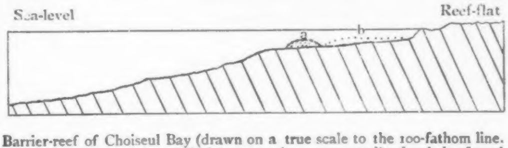
I paid especial attention to the inter-tidal exposure of living corals, and was much surprised at the number of species which are bared by the ebbing tide. Of all the corals in these islands, those belonging to the genus *Cœloria* seem to be the hardiest in this respect. In the paper I have described my observations with some detail.

Coral Reefs and Shoals.—The earliest condition of the coral reefs in this group is to be found in that of the numerous detached submerged reefs or shoals which lie below the limit of the constructive power of the breakers, having been arrested in their upward growth at depths varying between 5 and 10 fathoms according to the exposed or protected character of their situation. This remarkable fact of the arrest of the upward growth of the coral at these depths was utilised by Lieut.-Commander Oldham whilst surveying these submerged reefs in H.M.S. *Lark.* If a shoal was not marked at the surface by a reef-flat or by an islet, we could sail over it with perfect safety. The broken water of the tide-rip that indicated these shoals was no source of danger for a vessel of light draught. In my paper I have given evidence to prove that a shoal which was found by Bougainville in 1768 to be covered by 5 fathoms, remains in the same condition at the present day. The number of coral shoals possessing these characters led me to the conclusion that isolated submerged reefs are unable without the assistance of a movement of elevation to raise themselves to within the constructive power of the breakers. When they have reached their upward limit, they extend laterally, forming ultimately flat-topped shoals. It may appear bold to suggest that atolls and barrier-reefs owe their appearance at the surface to a movement of elevation; but we know that in the regions occupied by the atolls of the Low Archipelago, of the Fiji Islands, and of the Pelew Group, the last movement experienced has been one of elevation; whilst the observations of Mr. Beete Jukes on the Australian Barrier-Reef go to show that, if there has been a recent change of level in that region, it was one of the same nature. In the atoll of Oima in the Solomon Group I found evidence of an anterior elevation.

In my paper I proceeded to describe at some length the reefs that have reached the surface. In this abstract, however, I can only refer to the fact that all the three classes of reefs are to be found in this group; the atolls, I should add, being comparatively few in number and of small size.

The Formation of Atolls.—My observations go to show that atolls of small size (a mile or two across) do not assume their characteristic form until they have reached the surface. After upheaval has brought a submerged coral shoal within the constructive power of the breakers, it soon appears at the surface as an isolated patch of reef. Extensions or wings grow out on either side, and, guided by the prevailing currents (in the manner described by Semper), they ultimately form the common horse-shoe reef, which presents its convexity against the currents. Large atolls evidently begin to assume their characteristic shape below the surface as described by Murray and A. Agassiz.

The Formation of Barrier-Reefs.—The facts on which my conclusions have been based were obtained by the examination of the weather slopes of reefs. For the first 70 or 80 yards from the weather edge of a reef there is a gradual slope, largely bare of living coral, to a depth of 4 or 5 fathoms. There is then a rapid descent to a depth varying between 12 and 18 fathoms. It is this declivity that constitutes the growing edge of the reef, and the sand and gravel produced by the constant action of the breakers collect at its foot. When the submarine slope is more than 10° or 12°, as is usually the case, the sand and gravel extend far beyond the depths in which reef-corals thrive; but when the slope is gradual, *i.e.* less than 5°, the lower margin of this band of detritus lies within the reef-coral zone, and in consequence a line of barrier-reef is ultimately formed beyond this band with a deep-water channel inside (*vide* diagram). Should the



Barrier-reef of Choiseul Bay (drawn on a true scale to the 100-fathom line. *a* = incipient barrier-reef (size purposely exaggerated); *b* = belt of sand and gravel.

area be undergoing elevation, a succession of concentric lines of barrier-reefs will originate, line after line being advanced as fresh portions of the sea bottom are brought towards the surface, each line growing upward along the lower margin of the band of detritus derived from the line of reef inside it. In such a manner have the Shortland Islands been produced. When I arrived at the above conclusion I was not aware that substantially the same explanation had been advanced thirty years before by

[1] Abstract of a Paper by H. B. Guppy, M.B., late Surgeon H.M.S. *Lark.* Communicated by Dr. John Murray to the Royal Society of Edinburgh on July 5, 1886.

Prof. Joseph Le Conte in the instance of the Florida reefs. He then pointed out that since corals will not grow on muddy shores or in water upon the bottom of which sediment is collected, the favourable conditions can only be obtained at some distance from the shore, where a barrier-reef would ultimately be formed *limited on one side by the muddiness and on the other by the depth of the water*.

The foregoing conditions may be described as the determining causes of a barrier-reef. After the reef has been formed, the lagoon-channel will be kept open by such agencies as solution, diminished food-supply, tidal scour, organic degradation, and other influences. The circumstance that barrier-reefs are frequently situated at or near the borders of submarine plateaus receives a ready explanation in the view first advanced by Prof. Le Conte, since in such situations the necessary conditions of depth and clearness would be found.

Anomalous Depths of some Atolls and Barrier-Reefs.—One of the principal arguments in favour of the theory of subsidence lies in the assertion that lagoons and lagoon-channels are sometimes deeper than the reef-coral zone. I will, however, endeavour to show that this assertion is founded on a misconception of the conditions that limit the depth of this zone. The extent to which the depth may vary is demonstrated in the great divergence between the estimates of different observers in every region of coral reefs. Those of Quoy and Gaimard, Ehrenberg, Darwin, Dana, Murray, A. Agassiz, and others, range from 5 to 40 fathoms. But this variation may also be found in the same region of coral reefs. Thus, in the Solomon Islands, I found that the depths at which reef-corals flourished ranged in different localities from 12 to 40 fathoms and beyond, the variation being due to differences of local conditions, such as the degree of inclination of the submarine slope, the presence and position of submarine declivities, the amount of sediment held in suspension, the force of the breakers, and other influences. The main determining condition, as Prof. A. Agassiz points out, is to be found in the injurious effect of sand and sediment rather than in the general influence of depth; and the distribution of these materials is dependent on the local conditions above referred to. Local conditions will usually restrict the reef-coral zone to depths less than 30 fathoms; but, where there is a gradual submarine slope, reef-corals are to be found in depths beyond the sand and gravel. Inasmuch as most observers have regarded these materials as necessarily limiting the zone, they did not push their inquiries beyond. Under favourable conditions, however, reef-corals may thrive in depths of 50 or 60 fathoms; and thus we can readily explain the apparently abnormal depths inside some atolls and barrier-reefs.

An apparent objection here presents itself. If reefs begin to build their foundations in depths greater than those which are generally assigned to them, the thickness of the elevated reef-formations discovered by me in the Solomon Group should have been much greater than 150 feet, the actual limit of their thickness. It will, however, have been gathered from the previous remarks that local conditions will usually confine reef-corals to depths less than 25 or 30 fathoms, and that it will be only under occasional circumstances that reefs will commence to be formed in deeper water. Fringing-reefs themselves are at first restricted to shallow waters around the coast, and their seaward extension in localities where the submarine slope is at all steep, as is generally the case, must be extremely slow. Again, in an area of elevation, such as that in which the Solomon Islands are included, barrier-reefs, which may have begun to grow in depths not less than 50 fathoms, might owe their approach towards the surface as much to the elevating movement as to the very slow upward growth of the corals. It should also be borne in mind that the rapid subaërial denudation, to which these regions of heavy rainfall are subjected, would be an important agency in the thinning away of the raised coral formations.

In the latter part of my paper I refer, amongst other subjects, to the extensive character of the degradation of coral reefs by multitudes of organisms. I also give proofs of the outward growth of reefs on their own talus (as described by Murray)—(1) in the circumstance that massive corals may be commonly observed to increase in size as one approaches the lagoon from the outer margin of the reef-flat; (2) in the presence of old lines of erosion evidently produced at the existing sea-level, but which have been cut off from the action of the waves by the advancing edge of the reef-flat; (3) in the characters and position of the wooded islets situated on reefs, which in course of time would cover the whole reef-flat, were it not for one counteracting circumstance, the seaward growth of the reef.

Lastly, I refer to the deposits at present forming on the outer slopes of reefs in depths down to 100 fathoms. Reef-debris, foraminiferous tests, especially of *Orbitolites*, joints of the calcareous alga *Halimeda opuntia*, portions of *Nulliporæ*, and the small detached corals of the genus *Heteropsammia*, enter largely into the composition of these deposits. I should add that a rock of this composition is one of the commonest types of the so-called coral limestones in the Solomon Group.

In this short abstract of a long paper I have not been able to do much more than indicate the general bearing of my conclusions. The facts and data are given at length in the original paper.

THE BRITISH ASSOCIATION AND LOCAL SCIENTIFIC SOCIETIES

THE second annual Conference of Delegates held under the new rules of the British Association met at Birmingham on September 2 and 7, in the library of the Medical Institute. Forty-nine local Societies carrying on work in various parts of the United Kingdom have been enrolled this year as "Corresponding Societies" of the Association, and of these thirty-two were represented by Delegates at the Birmingham meeting. The following report of the proceedings of the Conference, signed by Mr. Francis Galton and Prof. R. Meldola, the Chairman and Secretary of the Committee, has just been circulated among the Corresponding Societies, and it will be seen that this new branch of the work of the Association promises to be of mutual advantage both to the Societies and the Association:—

At the first Conference the chair was taken by Dr. A. W. Williamson, F.R.S., General Treasurer of the British Association, the Corresponding Societies Committee being represented by Captain Douglas Galton, F.R.S., General Secretary of the Association, Dr. Garson, Mr. John Hopkinson, F.L.S., and Prof. R. Meldola, F.R.S., Secretary.

The Secretary read the Report of the Corresponding Societies Committee which had been presented to the Council of the Association.

The Chairman made some remarks explanatory of the objects of the Conference of Delegates, and suggested that among other subjects of investigation in which it might be useful to secure the co-operation of the local Societies was that of injurious insects, already so much studied by Miss E. A. Ormerod.

The Secretary also made some observations in explanation of the constitution of the Corresponding Societies Committee and the relations existing between the Conference of Delegates and the British Association.

Some remarks were made by Mr. J. W. Davis and others with reference to the advisability of securing the co-operation of the local Societies for the purpose of in-

vestigating British Barrows and other prehistoric remains. This suggestion had been put forward at the Aberdeen Conference last year by Prof. Meldola, and a Committee was about to be formed by Section H for carrying out this object.

Mr. H. Heywood considered that the relationship now existing between the British Association and the Corresponding Societies had already been of great assistance to the Societies themselves. In the case of his own Society (Cardiff) they had been able to assist one of the Committees (Erratic Blocks) brought under the notice of the Aberdeen Conference last year.

Prof. Lebour stated that many of the local Societies, such as the North of England Institute, which he represented, were composed of engineers connected with large works, who might make useful investigations which would be facilitated if backed up by the authority of the British Association. For this reason he hoped that other subjects besides natural history, geology, or anthropology would be recognised at the Conferences.

Captain Galton explained that the object of the Conference of Delegates was to bring the Corresponding Societies into direct communication with *all* the Committees of the British Association, to which the local Societies or individual members of these might render assistance. This could of course be only effected by degrees, but he suggested that as a preliminary step it might be found useful to place the Delegates on the Committees of those Sections in which they or their Societies had the most interest.

Dr. Williamson supported this proposition, and the Secretary took down the names of the Delegates to be attached to the various Sectional Committees.

Prof. Hillhouse and Dr. Garson expressed their willingness, as Secretaries of Sections D and H respectively, to propose Delegates as members of the Sectional Committees.

Mr. Hopkinson suggested that among other methods of promoting work among local Societies it might be found advantageous for the Delegates themselves to make suggestions at the Conference which might lead, through the proper channels, to the formation of new Committees by the British Association. He stated that his own Society (Hertfordshire) had already rendered material assistance to the Erratic Blocks Committee of the Association, and they hoped to render similar service to the Underground Waters Committee.

The following resolution, framed with the object of keeping the Corresponding Societies informed of the work being done by the British Association Committees, was moved by Dr. Garson, seconded by Captain Galton, and passed unanimously :—

"That the Secretary of the British Association be requested to send a list of the several Committees appointed by the Association to each of the Delegates of the Corresponding Societies, or to the Secretaries of these Societies, as soon as possible after the meeting of the Association, together with a copy of the proceedings of the meetings of the Conference of Delegates."

At the second Conference the chair was taken in the absence of Dr. Williamson by Prof. Boyd Dawkins, F.R.S., the Corresponding Societies Committee being represented by Dr. Garson, Mr. John Hopkinson, F.L.S., and the Secretary, Prof. R. Meldola, F.R.S.

The Secretary read the minutes of the proceedings of the first Conference, and it was stated that in accordance with the decision then arrived at the Delegates had been placed on the respective Sectional Committees as "Delegate Members."

The Chairman directed attention to the kind of work which might be done at the Conferences, stating that as a member of the Council of the British Association he knew that the Association was anxious to consolidate the work of the local Societies. He suggested that the best mode of procedure would be to take the different Sections *seriatim*, and hear the recommendations forwarded by the Committees of these Sections, together with suggestions by the Delegates respecting the lines of investigation in which the local Societies could take part.

SECTIONS A AND B.—No recommendations from the Committees of these Sections having been forwarded to the Secretary of the Conference, the Chairman invited suggestions from the Delegates.

Luminous Meteors.—Mr. F. T. Mott suggested that much useful work might be done if the local Societies would undertake to record systematically the appearance, position, direction, &c., of luminous meteors.

The Secretary stated that a Committee of the British Association was for many years in existence for the purpose of carrying out these observations, but, for some reason unknown to him, the Committee appeared now to have ceased its labours.

Magnetic and Tidal Observations.—Mr. J. Martin White suggested that some of the local Societies which were favourably situated for the purpose might undertake systematic observations of local tidal and magnetic phenomena.

Meteorological and Phenological Observations.—Mr. Heywood stated that many valuable meteorological observations were buried in the log-books of steamships, and suggested that some of the local Societies might render good service to meteorology by examining these books and keeping records of any important entries. Mr. Hopkinson pointed out two ways in which the local Societies might advance meteorological science. In the first place he thought that many observers in different parts of the country might be in the habit of recording the rainfall or other meteorological phenomena without communicating the results to Mr. Symons. Good service would be rendered if the Corresponding Societies would find out such observers and put them into communication with Mr. Symons.[1] In the next place he suggested that observations of the time of flowering of plants, first appearances of birds and insects, &c., might be systematically recorded and forwarded to the Royal Meteorological Society by those observers who had not hitherto been in the habit of communicating their results to that Society.

SECTION C.—Mr. C. E. De Rance, F.G.S., attended the Conference on behalf of the Committee of this Section. The three following recommendations were forwarded by the Secretary of the Section :—

Sea Coasts Erosion.—"That Messrs. R. B. Grantham, C. E. De Rance, J. B. Redman, W. Topley, W. Whitaker, and J. W. Woodall, Major-General Sir A. Clarke, Admiral Sir E. Ommanney, Sir J. N. Douglass, Captain J. Parsons, Captain W. J. L. Wharton, Prof. J. Prestwich, and Messrs. E. Easton, J. S. Valentine, and L. F. Vernon Harcourt be reappointed a Committee for the purpose of inquiring into the Rate of Erosion of the Sea Coasts of England and Wales, and the influence of the Artificial Abstraction of Shingle or other Material in that Action ; that Messrs. De Rance and Topley be the Secretaries."

Underground Waters.—"That Prof. E. Hull, Dr. H. W Crosskey, Captain Douglas Galton, Prof. J. Prestwich, and Messrs. James Glaisher, E. B. Marten, G. H. Morton, James Parker, W. Pengelly, James Plant, I. Roberts, Fox-Strangways, T. S. Stooke, G. J. Symons, W. Topley, Tylden-Wright, E. Wethered, W. Whitaker, and C. E. De Rance be reappointed a Committee for the purpose of investigating the Circulation of the Underground Waters in the Permeable Formations of England, and the Quality and Quantity of the Waters supplied to various towns and districts from these formations ; and that Mr. De Rance be the Secretary."

Erratic Blocks.—"That Profs. J. Prestwich, W. Boyd Dawkins, T. McK. Hughes, and T. G. Bonney, Dr. H. W.

[1] G. J. Symons, F.R.S., 62, Camden Square, London, N.W.

Crosskey, and Messrs. C. E. De Rance, H. G. Fordham, J. E. Lee, D. Mackintosh, W. Pengelly, J. Plant, and R. H. Tiddeman be reappointed a Committee for the purpose of recording the position, height above the sea, lithological characters, size, and origin of the Erratic Blocks of England, Wales, and Ireland, reporting other matters of interest connected with the same, and taking measures for their preservation; and that Dr. Crosskey be the Secretary."

Mr. De Rance described the above three inquiries undertaken by Section C, in which it was thought the Corresponding Societies could render valuable assistance. Forms of inquiry had been circulated largely by these Committees, and it was suggested that any work done by the Corresponding Societies should be on these forms printed by the British Association. Mr. De Rance stated that forms would always be supplied to the Secretaries of Corresponding Societies applying for them.

Dr. Crosskey made some remarks explanatory of the work of the Erratic Blocks Committee. He stated that the assistance of the local Societies would be particularly valuable in this inquiry, and that he would be happy to supply the necessary forms to the Corresponding Societies in the hope that they would be filled up. He urged upon the Delegates the necessity for preserving these boulders, which were everywhere being broken up, and were rapidly disappearing from off the face of the country.[1]

Earth-Tremors.—Prof. Lebour stated that for some time past the North of England Institute of Mining and Mechanical Engineers had had a Committee actively engaged on the subject of earth-tremors and their possible connection with mine-explosions. This subject was naturally related to those of Sections A, C, and G of the British Association, and its investigation might be powerfully promoted by them. Some of the Corresponding Societies might aid greatly in making and recording observations on earth-tremors in various parts of the country. The more extensive the area over which such observations were made (if by competent observers and with suitable instruments) the more valuable they become; but it was very important that there should be some general understanding between the observers in different parts of the country, in order that some degree of that uniformity which is so desirable in matters of this kind should be attained. The cost of the expensive instruments necessary would be much lessened if large numbers of them were used. The question of earth-tremor observations was only one of many in which the engineering Societies and the British Association could be mutually useful, the former carrying out the work and the latter lending the influence of its official recognition and support.

The Rev. J. M. Mello stated that colliery proprietors were generally unwilling to spend money in investigations unless some very specific form of inquiry was circulated.

Mr. Hopkinson remarked that the Corresponding Societies, if supplied with the necessary forms, would no doubt be willing to circulate them among their members. Mr. Heywood thought the suggestion for observing and recording earth-tremors a most valuable one, and he remarked that the Cardiff Society would be happy to assist in the investigation if the formation of a Committee was sanctioned by the Association.

SECTION D.—The Committee of this Section was represented by Prof. W. Hillhouse, M.A., F.L.S.

Preservation of Native Plants.—In reply to a question by the Secretary, Prof. Hillhouse stated that in response to the inquiries which he had circulated among the Delegates and others likely to furnish information, he had received details from twelve or fourteen localities recording between two and three hundred disappearances of plants. Mr. Stirrup stated that for years past a great destruction of plants had been going on in the Manchester district, and the local Societies had found it necessary to strongly inculcate among their members the necessity of preventing this extermination. Mr. Hopkinson remarked that a similar rule had been always observed by the Hertfordshire Society with respect both to animals and plants, and he thought that all the local Societies should adopt it. Mr. Mott pointed out that one practical result illustrating the benefit of Prof. Hillhouse's resolution had been the omission of the localities of all the rare ferns and orchids from the flora of Leicestershire, which his Society was just about to publish.

Local Museums Committee.—Mr. Mott stated that a joint Committee, composed of representatives of Sections C and D, had been recommended for appointment for the purpose of reporting upon the provincial museums of the United Kingdom. The work of this Committee would be much facilitated by the co-operation of the local Societies, and he hoped that the Delegates would bring the matter under the notice of their respective Societies. The Committee consists of Mr. V. Ball, Mr. H. G. Fordham, Profs. Haddon and Hillhouse, Dr. Macfarlane, Prof. Milnes Marshall, Mr. Mott (Secretary), Dr. Traquair, and Dr. Henry Woodward.

In reply to a question as to whether the work of this Committee was to be confined to public or to extend to private museums, Mr. Mott stated that it might be found desirable to extend the report to some few private museums.

The Chairman remarked that the Local Museums Committee was one of the most important that had yet been formed. The local museums of this country were generally in a most deplorable state, and one of the first things to be done was to exclude from such collections all extraneous specimens that were not truly local. According to his experience, he had found that it was impossible for a local Society to flourish and at the same time to carry on a large museum successfully. The two organisations should be independent, but at the same time it was most desirable that the objects collected by local Societies should be handed over to the nearest local museum. With reference to this question of local museums, he considered that we in this country were much behind Germany, America, and France.

A short discussion took place with reference to the naming of specimens in local museums, in which Mr. Eve, Mr. Hopkinson, and the Chairman took part.

SECTION H.—The Committee of this Section was represented by Dr. Garson, who stated that one Committee which was about to be formed on the recommendation of their Section had arisen from the suggestion made by Mr. J. W. Davis at the last Conference.

Prehistoric Remains.—The following is the resolution sent up to and adopted by the Committee of Recommendations:—"That Sir John Lubbock, Dr. R. Munro, Mr. Pengelly, Prof. Boyd Dawkins, Dr. Muirhead, and Mr. J. W. Davis be appointed a Committee to ascertain and record the localities in the British Islands in which evidence of the existence of prehistoric inhabitants of the country is found."

Prof. Meldola stated that three years ago he had brought this subject under the notice of the Delegates in a paper which he had read at the Southport meeting of the Association, and which had been published in abstract in the volume of Reports for 1883, and *in extenso* in the *Transactions* of the Essex Field Club.[1] He remarked that the work which the Committee proposed to undertake was of the greatest national importance in view of

[1] The addresses of the Secretaries of these three Committees are:—
Underground Waters.—C. E. De Rance, F.G.S., A.I.C.E., 28, Jermyn Street, London, S.W.
Erratic Blocks.—Rev. H. W. Crosskey, LL.D., F.G.S., 117, Gough Road, Edgbaston, Birmingham.
Sea Coasts Erosion.—Wm. Topley, F.G.S., A.I.C.E., 28, Jermyn Street, London, S.W.

[1] See NATURE, vol. xxix. p. 19.

the great destruction of ancient remains that had been going on for many years.

The Chairman remarked that the subject was undoubtedly one of great importance, and some of the local Societies had already commenced to record the position of these remains on the Ordnance maps. He stated that according to his experience the 1-inch map could be used, but the 6-inch map would be found much better. One desideratum in the work was a good system of symbols; such a system had been employed in a map of ancient remains recently published in France, and he stated that he should be happy to place this system at the disposal of the Committee. He added that he was glad to be able to announce that he had succeeded in getting an Act passed for the preservation of the ancient monuments of the Isle of Man.

Preservation of Stonehenge.—Dr. Garson stated that the Committee of Section H had forwarded a resolution to the Committee of Recommendations with reference to the preservation of Stonehenge, and, pending its consideration by this Committee, it had been suggested that it should also be brought under the notice of the Corresponding Societies through their Delegates, with the object of these using their influence, as far as possible, for the preservation of this and other monuments throughout the country. The following is the resolution referred to:[1]—"That the attention of the proprietor of Stonehenge be called to the danger in which several of the stones are at the present time from the burrowing of rabbits, and also to the desirability of removing the wooden props which support the horizontal stones of one of the trilithons, and, in view of the great value of Stonehenge as an ancient monument, to express the hope of the Association that some steps will be taken to remedy these sources of danger to the stones."

This resolution had originated last April during a joint meeting of the Geologists' Association and the Hampshire Field Club on Salisbury Plain, when copies were ordered to be forwarded to the proprietor, to the Inspector of Ancient Monuments, and to the Secretary of the Corresponding Societies Committee of the British Association. The proprietor of these valuable remains had hitherto refused to take advantage of the Ancient Monuments Act, though repeatedly requested to do so, neither had he paid due attention to their proper preservation, so that it had been thought desirable to move the foregoing resolution which had been sent to the proper quarter for confirmation by the General Committee of the Association.

Election of Corresponding Societies.—At the termination of the Conference, Mr. Davis raised the question whether a Corresponding Society when once admitted by the Association should not always be retained on the list.

The Secretary explained that the election of Corresponding Societies took place *annually*, and that each of these Societies would be expected to make an annual application for re-election on the printed forms sent out before June. There was no reason why a Society when once elected should not be re-elected every year as long as it kept up its scientific activity. He was of opinion that a failure on the part of a Corresponding Society to send a Delegate to any meeting of the Association should not disqualify that Society for re-election, although it was expected that when a Delegate did attend the meeting of the Association he should be present at the Conferences. Prof. Meldola further stated that some few of the Societies which had been elected last year did not appear in this year's list, the reason being that the Secretaries had not filled in and returned the printed forms sent out at the beginning of the year, nor had any notice been taken of a second application asking whether it was the wish of their Society to be re-elected; so that, as Secretary of the Corresponding Societies Committee, he had concluded that these Societies desired to withdraw, and they had accordingly been removed from the list.

[1] This resolution was adopted by the Committee of Recommendations and confirmed by the General Committee.

THE COLONIAL AND INDIAN EXHIBITION

RESUMING our notes on some of the principal exhibits (NATURE, vol. xxxiv. p. 548), the Court running parallel with and between those of Mauritius and Seychelles on the one side and Cyprus and Malta on the other was that which contained the collection from the

West Indies.

Vegetable products, as might be expected, formed the bulk of the exhibits in this attractive Court, which had an air of comfort and finish not excelled in any other part of the building. Entering the Court from the northern end, the first bay on the left hand was devoted to

Trinidad, an island celebrated both for the quantity and quality of the cocoa grown upon it, which indeed is the staple article of produce. The value of cocoa exported from Trinidad in 1885 is stated in the Official Hand-book to have amounted to 421,974*l.*, and in some "Notes on Trinidad Industries," by Mr. John McCarthy, F.C.S., the Assistant Commissioner for Trinidad, recently published, it is stated that the quantity of cocoa imported into England in 1885 amounted to 10,560 tons, against 10,120 tons in 1884, and 9986 in 1881. Numerous specimens of cocoa seeds are exhibited, as well as prepared cocoa and chocolate.

Mr. McCarthy describes the cultivation of the cocoa-nut (*Cocos nucifera*) as a very profitable industry, though the tree does not bear much before it is eight years old. Experiments, he tells us, "are now being tried in Trinidad to make it act as a shade tree to the cocoa (*Theobroma*)" instead of planting the quick-growing "Bois immortelle." The idea of this planting is to realise from the same land a double crop, namely, that from the *Theobroma* and that from the *Cocos*. It is estimated that seventy trees planted upon an acre of land would, when in full bearing, yield 5000 nuts per annum, which would net, on an average, from 3*l.* to 4*l.* per thousand in Trinidad. The annual import of nuts into London is said to be about 12,000,000, besides which, New York imports enormous quantities, and they are also used to a very large extent for the expression of oil in Trinidad itself. Coffee has also a prominent place in the products of Trinidad, and the plant is stated to thrive well, although it has not yet produced even sufficient coffee for home consumption. More attention has, however, been directed of late to coffee culture in the island, so that it is largely increasing. The cultivation of tobacco is also an industry that promises to become of some importance, and the tobacco is described as being second only to the finest Havana. There is a good exhibit of cigars, which are said to have met with general favour, so that a demand has arisen for them.

Bahamas.—In the Official Hand-book, Sir Augustus Adderley gives a very readable sketch of the history of these islands, and briefly refers to the natural products, foremost amongst which are corals and sponges. He describes the "sponging and wrecking vessels" as fine models and fast sailers, built by the islanders of native hard wood known as "horseflesh," and planked with yellow pine obtained from North Carolina. Conch shells are exported in large quantities to the value of about 1200*l.* per annum, and the pale pink pearls which are found in them to the extent of 3000*l.* per annum. The sponge exports were estimated at 60,000*l.* for 1885. Mention is made of the abundance of plants valued as medicines, many of which might be further developed by systematic trial of their effects in this country. Perhaps the two best known medicinal plants are the Canella Bark (*Canella alba*, Murr.) and the Sweet Bark or Cascarilla

(*Croton Eleuteria*, J. J. Benn.). The first has a bitter, acrid, and pungent taste, and a cinnamon-like smell. With us it is used as an aromatic stimulant, and as a condiment in the West Indies. The sweet bark is a bitter aromatic tonic, formerly used as a substitute for Peruvian bark, but now chiefly as an ingredient in pastilles and for mixing with tobacco for the sake of its pleasant musky odour. The cultivation of perfume-yielding plants is recommended as a probable commercial success, the demand for perfumes at the present time being so great that it has even been proposed to cultivate in Australia on a large scale such plants as are now grown at Grasse, Nice, and Cannes.

Jamaica.—The contents of this Court were both numerous and varied. Rum and sugar were fully illustrated by a large number of samples. Coffee was also well represented; of this article the Official Catalogue states that two distinct classes are produced in the island, the total annual export being about 84,000 cwt. per annum, of which about 10,000 cwt. is Blue Mountain coffee, a fine quality, consigned almost entirely to the Liverpool market. Pimento or allspice is a product exclusively of Jamaica, where it is grown in plantations or gardens known as "pimento walks." The commercial article consists of the dried berries, which were exported from Jamaica to the value of 53,867*l*. in 1885. It is very largely used as a spice as well as in medicine, on account of its aromatic and stimulant properties. The fruits contain a quantity of oil, which is obtained by distillation, and is used in perfumery and for similar purposes to which clove-oil is put. Pimento-sticks are amongst the strongest and best for walking-sticks and umbrella-handles, on account of their strength, rigidity, and non-liability to crack. The pimento-tree is of low growth, and is known to botanists as *Pimenta officinalis*.

In this Court were shown some remarkably fine samples of Annatto seeds (*Bixa Orellana*), noted for their plumpness, as well as for their bright colour, the waxy coating of the seeds being highly valued as a red colouring-matter. A large and interesting collection of fruits preserved in a salt-solution were here shown; amongst others the following will attract attention: Star-apple (*Chrysophyllum Cainito*), Cocoa-plum (*Chrysobalanus Icaco*), Blimbing (*Averrhoa Bilimbi*), Akee (*Cupania edulis*, better known, perhaps, as *Blighia sapida*). Many of these are the produce of introduced plants, and the fruits are for the most part fine examples. Amongst a number of specimens of essential oils from well-known plants, most of which are apparently of excellent quality, are some that are but very little known, such, for instance, as those from the Bermuda Cedar (*Juniperus bermudiana*), the Mountain Cigar Bush (*Hedyosmum nutans*), Mountain Thyme (*Micromeria obovata*), Cigar Bush (*Critonea dalea*), and the Sand Box-tree (*Hura crepitans*).

Barbados.—The exhibits from this island consisted largely of similar produce to the islands already referred to. As illustrating the extent of land occupied by sugar cultivation, it is stated in the introductory notice of Barbados in the Official Hand-book, by the Hon. C. C. Knollys, that "out of a total acreage of 106,470 acres, an area of 100,000 acres is devoted to canes." Tobacco is recommended for extended cultivation, and root-crops such as arrowroot and cassava give heavy returns.

British Honduras.—We take this dependency in this order, as it occupied a position in the Exhibition next that of Barbados. The importance of timber in the produce of British Honduras is seen by a simple glance at the exhibits, and to the future development of these timber resources lies in a very great measure the future prosperity of the colony. In the introductory notes to these exhibits the following paragraph occurs:—"To its timber and dye-woods the colony of British Honduras owes its existence, and whatever measure of progress and advancement it may have attained. To the discovery, first of logwood, and subsequently of mahogany, its original settlement must be ascribed." Notwithstanding the importance of the forest produce, very few of the timbers are yet known either to commerce or to science, but many of them are of exceptional hardness and beauty. Mahogany is, of course, the most important wood in the colony, and, next to it, the cedar (*Cedrela adorata*), which is not only exported to a very large extent, but is also used in the colony for light indoor work—cigar-boxes, trunks, packing-cases, and for dug-out canoes, several of which were exhibited. Amongst a collection of lianes, or climbing-plants, is a specimen of the chew-stick (*Gouania domingensis*), with the singular information, besides that of its use as a tooth-brush and tooth-powder, that "it is used in place of yeast to start fermentation in making ginger- and spruce-beer, &c." Probably the most striking object in this Court is a large and beautifully figured slab of mahogany; the dark wavy cross-markings are extremely beautiful and very remarkable in this wood; the plank is, moreover, without a flaw.

Dominica.—The space occupied by this island, as well as by the remaining colonies, was small; the exhibits on the whole, however, were interesting, and some were worth noting, such, for instance, as the husks or shells of the Liberian coffee, which are said to be worth from 1 to 2 cents. per pound in the United States, the fruits of *Acacia Farnesiana*, stated to be used in tanning, and bark of Guava, the *Psidium Guayava*, which is rich in tannin, and is used as an astringent. Raw lime-juice is exported from Dominica in increasing quantities, but the greater part of the juice is boiled down until ten or twelve gallons are reduced to one, and is shipped in this concentrated form to England and the United States for the manufacture of citric acid.

Montserrat.—Sugar and lime-juice are the principal staples of this island, and these were the most prominent exhibits.

St. Kitts and the Virgin Islands.—From these islands the exhibits were but small, and without special interest.

Antigua.—The chief product of this colony is sugar, the average crop of which for the last twenty years is stated to have been about 12,000 hogsheads. Yams, potatoes, and Guinea corn are also grown in large quantities for native consumption. The exhibits were for the most part such as were shown in other West Indian Courts.

Grenada.—Cocoa is the most important article grown here, and some very fine fruits of good colour were shown, as well as nutmegs (*Myristica fragrans*) custard apples, or bullock's heart (*Anona reticulata*), papaws (*Carica Papaya*), Kola nuts (*Cola acuminata*). These latter were remarkably fine specimens. A good deal of attention, we are glad to see, has recently been paid to its cultivation. The tree exists in all parts of the island, and was introduced in years past by the African slaves, who used to regard it as a specific against intoxication.

Tobago.—The productive resources of this small island are varied, and were well exemplified in the collection of fruits, seeds, fibres, &c. The collection of preserved native fruits in syrup, and jellies prepared from them, was a special feature in this Court, a sample of preserved or candied papaw (*Carica Papaya*) being especially good.

St. Lucia.—Sugar, rum, and molasses are the chief products; cocoa and logwood are also produced in quantities, though the latter is stated to be at the present time a drug in the market. Tobacco, it is stated, has been tried in one district with most satisfactory results, so that it is purposed to extend its cultivation. Neither the individual exhibits in this Court, nor in the remaining one of St. Vincent, call for any special remark. We cannot conclude our notice of the West Indian exhibits without a reference to the series of over 100 water-colour drawings, by Mrs. Blake, illustrative of the flora of the West Indian Islands.

JOHN R. JACKSON
Museum, Royal Gardens, Kew

NOTES

THE President and Council of the Royal Society have this year awarded the Copley Medal to Franz Ernst Neumann, of Königsberg (For. Mem. R.S.), for his researches in theoretical optics and electro-dynamics, and the Davy Medal to Jean Charles Galissard de Marignac, of Geneva (For. Mem. R.S.), for his researches on atomic weights. Prof. S. P. Langley was awarded the Rumford Medal for his researches on the spectrum by means of the bolometer. The Royal Medals have, with the approval of Her Majesty, been awarded to Mr. F. Galton and Prof. Guthrie Tait, the former eminent for his statistical inquiries into biological phenomena, and the latter for his various mathematical and physical researches. The medals will be presented at the anniversary meeting on November 30.

MR. CHARLES WILLIAM PEACH, the eminent scientific observer, died in February last, and, not long afterwards, a memorial was addressed to the First Lord of the Treasury, praying that his daughter, Jemima Mary, might, on account of her very slender provision, be placed on the Civil List. The memorial, subscribed by about 140 eminent persons, resulted in a Treasury grant of 200*l.* being sent to Miss Peach, after the expiry of five months. The grant so made being totally inadequate by way of provision, while it fails to denote the high sense entertained of Mr. Peach's scientific services, it has been determined to secure, by private subscription, the means of providing Miss Peach with a permanent annuity. Of the sum necessary to effect this, the Treasury grant of 200*l.* will of course form the nucleus. The Committee believe it is unnecessary to do more than allude to Mr. Peach's more conspicuous services. For half a century he gratuitously supplied to contemporary inquirers the fruits of his research. When Mr. Hugh Miller was engaged in preparing his work on the "Old Red Sandstone," Mr. Peach conveyed to him those specimens from Caithness which materially availed him in illustrating his subject. By his discovery of Silurian fossils in the rocks of Cornwall, he enabled Sir Henry de la Beche, then at the head of the Geological Survey, to obtain a scientific basis for mapping the rocks of Devon and Cornwall. In connection with this important work, also, by his discovery of Lower Silurian fossils in the north-west of Scotland—thereby affording the key by means of which the structure and age of the rocks of the Scottish Highlands must be determined—it was the opinion of Sir Roderick Murchison that Mr. Peach had rendered service such as merited a special recompense from his country. From the Devonian rocks of Cornwall and the Old Red Sandstone of the north of Scotland he procured the fish fauna which supplied a share of the material used by Sir Philip Egerton, Prof. Huxley, and Prof. E. Ray Lankester in preparing their several descriptions. In their monographs, Mr. Darwin and Dr. Carpenter have acknowledged his valuable contributions to a knowledge of the Balanidæ and the Polyzoa, while many other naturalists were also indebted to him for most important zoological observations made along our coasts. Mr. Peach made a valuable collection of the fossils of Brora, Sutherlandshire (Jurassic), now in the British Museum. His discoveries have largely availed in elucidating the fossil flora of the Old Red Sandstone and the Carboniferous rocks of Scotland. In the department of recent marine animals and plants, he has added hundreds of new species to the British lists. In acknowledgment of his scientific acquirements, he received honours from the leading scientific Societies; and in 1875 he was awarded by the Royal Society of Edinburgh one of their gold medals. After twenty-one years of arduous labour in connection with the Coastguard, Mr. Peach was in 1845 transferred by Sir Robert Peel to the Department of Customs, as suggested by the Council of the British Association; but this change, while adding to his leisure, did not materially enhance his emoluments. In the public service his highest income was 150*l.*, his retiring allowance being 130*l.* Such remuneration as he received for his scientific services he applied exclusively to the cause of research. He attained his eighty-fifth year, and in his old age it was a source of deep anxiety to him as to how he should be able to provide for the devoted daughter to whose help and affectionate care he was so much indebted. Five hundred pounds are wanted, and this amount there ought not to be much difficulty in procuring. An account is opened in the Bank of Scotland, for the receipt of contributions, under the care of Mr. Robert Gray, Bank of Scotland, Edinburgh, as Treasurer of the fund. Among the members of the Committee are Sir William Turner, F.R.S.; Sir Joseph D. Hooker; Archibald Geikie, F.R.S., Director-General of the Geological Survey of Great Britain and Ireland; Prof. E. Ray Lankester, F.R.S.; Prof. Tait; John Murray, V.P.R.S.E., Director of the *Challenger* Expedition Commission, Edinburgh; William Pengelly, Torquay; and others.

OUR readers must have noticed the recent telegrams concerning the beleaguered position of Dr. Emin Bey at Wadelai, on the Upper Nile, some 50 miles north of Lake Albert Nyanza. Emin Bey was Governor of the old Equatorial Province of Egypt, and his administration of the province was of a model character. Moreover, he did much before the Mahdi insurrection broke out for the promotion of a knowledge of the natural history and geography of the Upper Nile region, as will be seen from his many communications to *Petermann's Mitteilungen*. His last communication is in the current number of the *Mitteilungen*, and is dated January last. In it, notwithstanding his critical position, he speaks of his collections. When the news of Emin Bey's position first reached this country, the Government regarded it as their duty to do what they could to rescue or succour him, and the Intelligence Branch of the War Office made all inquiries as to routes, among other things taking counsel with Mr. Joseph Thomson. There are many difficulties in the way, especially since the death of Mtesa, King of Uganda; but the Government, we believe, have by no means given up the idea of communicating with Emin Bey. Mr. Stanley has expressed his willingness to lead an expedition, and Mr. Thomson shows, in yesterday's *Times*, how the thing can be done. He believes rightly that the route across Masai Land followed by himself is the directest and shortest, and it is really not necessary to pass through Uganda at all; a sweep could be made round by Lake Baringo and the Suk country, and so westwards 300 miles to Wadelai. Moreover, it seems to us that the route by the west side of the Victoria Nyanza on to the Albert Nyanza is worthy of consideration. Certainly, if Mr. Thomson undertakes to lead a relief expedition, he could accomplish it speedily and peacefully. The English Government is bound to do everything in its power to prevent any disaster falling upon so valuable a life; and if they mean to do anything it ought to be quickly, or else it may be too late.

M. PASTEUR, according to the *Times* Paris Correspondent, exhausted by the incessant labours of the last few years, was to leave on Tuesday, by the advice of his family and friends, for Bordighera, where M. Bischoffsheim has placed his villa at his disposal. The *Times* Correspondent, before his departure, ascertained from M. Pasteur the precise state of the Pasteur Institute subscription and of his experiments. The subscription has now nearly reached 1,8[illegible]0,000f., but contributions still flow in, though rather more slowly, and M. Pasteur has reason to hope that we shall eventually reach the sum required. The Paris Municipality has given a gratuitous lease for 99 years of 2500 metres of ground, the site of the old Collège Rollin. This area being insufficient for the laboratories, not merely for rabies, but for other contagious maladies, he has asked for a lease for 99 years of 2500 metres adjoining, and he expected that this proposal

would be acceded to at Monday's sitting. A subscription is being raised among the brewers in England. M. Pasteur then goes on in his communication to describe the results of his operations much in the same terms as in his paper to the Paris Academy epitomised in a recent number of NATURE.

THE following are among the lectures to be given at the London Institution, during 1886-87:—Sir R. S. Ball, F.R.S., Astronomer Royal of Ireland, two lectures on "The Astronomical Theory of the Great Ice Age," one given last Monday, the other for November 29; Prof. E. Ray Lankester, F.R.S., six lectures on "The Elements of Biology," Thursdays, November 25, December 2, 9, 16, 23, 30; Prof. T. W. Rhys Davids, Ph.D., "Buddhism," Monday, December 13; Henry Seebohm, "Birds' Nests and Eggs," Monday, December 20; Eric S. Bruce, "War and Ballooning," Monday, December 27; Dr. C. Meymott Tidy, F.C.S., three lectures (juvenile) on "Chemical Action," Thursdays, January 6, 13, 20; Prof. W. H. Flower, F.R.S., Director of the Natural History Department, British Museum, "Fins, Wings, and Hands," Monday, January 17; Prof. Silvanus Thompson, Ph.D., two lectures on "Electric Bells," Thursdays, February 10, 17; Harold B. Dixon, F.R.S., "The Lighthouse Experiments at the South Foreland," Thursday, February 24. The Thursday lectures will be given at 6 o'clock, excepting on January 27, February 3, March 3, and March 10, when they will be given at 7 o'clock. The Monday lectures are at 5 p.m.

GENERAL J. F. TENNANT sends us the following additional information on the late Major-General John Theophilus Boileau, whose death we announced last week:—"General Boileau was selected to superintend one of the magnetic observatories established by the Honourable East India Company in 1843 in connection with the general scheme of magnetic observatories, and had charge of the Simla Observatory. Long after it was closed for observing purposes he was employed in reducing and publishing the results. He also published a collection of astronomical, magnetical, and meteorological tables, and a set of traverse tables; and possibly some special tables, which, being published in India, have never come into much use, and have practically been superseded by others more recent. General Boileau has long been annually appointed one of the Scrutators at the anniversary meeting of the Royal Society on St. Andrew's Day, and we shall miss there on Tuesday a familiar face and name. His energies and time have long been absorbed in institutions for helping those in want, especially the daughters of officers of the army and soldiers. And now his, in turn, want aid, which an influential Committee is endeavouring to raise for them. Will you lend the aid of your circulation to make known the want among those who can spare?"

WITH reference to the above note we heartily commend to our readers the proposal to raise by public subscription a testimonial in recognition of the devotion displayed by General Boileau over a long period of years in philanthropic works, especially those so ably and successfully carried out by him on behalf of the Royal School for Daughters of Officers of the Army at Bath, and the Soldiers' Daughters' Home at Hampstead. An influential Committee has been formed for giving effect to the proposal, with Field-Marshal the Lord Napier of Magdala, G.C.B., G.C.S.I., R.E., as Chairman, and Major-General Philip Ravenhill, C.B., as Honorary Secretary. It is contemplated that the amount collected will best be expended in purchasing annuities for certain members of General Boileau's family, who are at his death left in very straitened circumstances. The Committee appeal not only to those who are, or have been, connected with either of the two institutions above named, but also to General Boileau's numerous friends and acquaintances, to aid them in attaining the object they have in view. Subscriptions will be received by Messrs. Cox and Co., Craig's Court, London, S.W., by the Honorary Secretary, 50, Holland Road, Kensington, W., or they may be paid to any member of the Committee.

THE *Methodist Times* announces the formation of a "Wesley Scientific Society" for the purpose of promoting intercourse among Wesleyan students of science. It will aim at the encouragement of practical scientific work among amateurs, the guidance of beginners in the study of natural history, the interchange of opinions upon scientific questions, and the collection and circulation of useful facts and observations bearing upon the sciences in general. If sufficient support is promised, the first number of a monthly journal will be issued by next March. The President is the Rev. W. H. Dallinger, F.R.S., and the Secretary is the Rev. W. Spiers, M.A., F.G.S. The Vice-Presidents are Rev. G. Bowden, Rev. N. Curnock, A. C. Graham, M.A., C. W. Kimmins, D.Sc., J. Potts, F.G.S., and Rev. G. S. Rowe. The Rev. Dr. Dallinger, Rev. W. Spiers, and Rev. Hilderic Friend, F.L.S., will edit the Society's journal.

THE great refracting telescope of the Bischoffsheim Observatory is in full operation at Nice. It is second only to the Pulkowa instrument. Observations with it have been conducted most successfully.

ADMIRAL MOUCHEZ, Director of the Paris Observatory, has issued circulars in the name of the Committee for erecting to François Arago a statue on the southern part of the meridian line which passes through that establishment. Subscriptions are received at the Observatory by M. Mouchez. A sum of about 400*l.*, which had been collected for a similar purpose when Arago died thirty-two years ago, is in the hands of the Paris Academy of Sciences, and will be placed at the disposal of the Committee.

IT is stated that a subscription will be started at Auxerre, the native place of M. Paul Bert, for erecting a memorial on his behalf.

LAST week a boat containing fourteen persons was successfully worked on the Seine with artificial wings acting on the air, and propelled by a rotating wheel.

DR. FOREL informs us that earthquakes occurred in Switzerland on the following dates:—At Cernetz, Grisons, November 6, 17h. 44m., and at 19h. 59m.; November 7, at 1h. 28m.; over Switzerland, with centre in the Lake of Lucerne, on November 16, 2h. 15m. (all Greenwich times).

WE have received from Mr. J. White, photographer, of Littlehampton, a copy of the last portrait (cabinet) taken of the late Prof. Guthrie. It is a very good one.

DR. R. MULLINEUX WALMSLEY, D.Sc., Senior Demonstrator at the Finsbury Technical College, in the department of Applied Physics and Electrical Engineering, has been appointed Principal of the Technical College about to be established at Kurrachee.

THE decline of the Indian silk industry is a subject which has lately attracted some attention. Various causes have been assigned, such as rack-renting by the Zemindars, while the existence of any specific disease among the silkworms has been strenuously denied. The question seems at last to have been settled by the investigations of a skilled entomologist, Mr. Wood Mason, Curator of the Indian Museum, who, on examining a large number of living cocoons, received from various parts of the country, found over 60 per cent. so diseased that no moths emerged, while such moths as emerged were nearly all sickly and crippled, and only 6 per cent. lived to couple and lay eggs. A further examination showed that the cells of the silk glands, and all other tissues, including even the blood, were in the last stage of disease, and literally crammed with minute corpuscles,

identical with those which have been demonstrated to be the cause of the fibrine disease which, in an epidemic form, from 1849 to 1865 ravaged the silkworm nurseries of France, and reduced them to a state of ruin, but which, thanks to M. Pasteur, is now practically eradicated from Europe.

PROF. GIOVANNI LUVINI has just issued, in pamphlet form, a summary of the results of his important experiments on the electric conductibility of vapours and gases. As the readers of NATURE are already aware, these experiments have finally exploded the old theory that the moist atmosphere and other vapours are good conductors. The pamphlet, which is published in Florence, includes an historical survey of the subject, and a full account of the processes adopted by the author. Electricians are reminded that this essay, together with his previous treatise on atmospheric electricity, are merely preparatory to a comprehensive work on the phenomena connected with the aurora borealis, which is now nearly completed.

LIGHTNING-FLASHES have sometimes been observed which, starting from one point, have ended in several. Some remarkable forms of flash have been lately described by Herr Leyst, of Pawlowsk Observatory. In one case a flash went a certain distance in a north-easterly direction, then divided, the two branches forming an angle of about 75°. When these had reached about 35° from each other, they turned and united again to one line. The path of the lightning thus formed a quadrilateral figure. It was further observed that the lightning flashed back in the same path, as if there were an oscillating discharge. In another interesting flash, the path was not a crooked line but a wavy band, which was lit up four times in succession with equal brilliancy. The time between the second and third and the third and fourth flashes seemed longer than that between the first and second. The thunder which followed lasted about 80 seconds.

THE additions to the Zoological Society's Gardens during the past week include a Patas Monkey (*Cercopithecus patas* ♀) from West Africa, presented by Capt. T. W. Robinson; a Puma (*Felis concolor* ♂) from El Gran Chaco, presented by Mr. Alfred Grenfell, F.Z.S.; a Malayan Bear (*Ursus malayanus*) from Malacca, presented by Miss A. Stewart Saville; a —— Souslik (*Spermophilus* ——) from California, presented by Mr. B. F. Russell; a Gazelle (*Gazella dorcas* ♂) from Barbary, presented by Edward J. Hough; four Chukar Partridges (*Caccabis chukar*) from Persia, presented by Dr. J. Huntley; a —— Toad (*Bufo* ——) from Africa, presented by Mr. E. N. Wroughton; six Roseate Cockatoos (*Cacatua roseicapilla*), seventeen Cockateels (*Calopsitta novæ-hollandiæ*), six Swainson's Lorikeets (*Trichoglossus novæ-hollandiæ*), two Red-winged Parrakeets (*Aprosmictus erythropterus*), eight Chestnut-eared Finches (*Amadina castanotis*), two Peaceful Doves (*Geopelia tranquilla*) from Australia, a Nutmeg Bird (*Munia punctularia*), two Eastern Turtle Doves (*Turtur meena*) from India, three Magpie Tanagers (*Cissopis leveriana*), two Red-crested Cardinals (*Paroaria cucullata*), a Red Ground-Dove (*Geotrygon montana*), a Yarrell's Curassow (*Crax carunculata*), a Crested Curassow (*Crax alector*) from South-East Brazil, two Hawfinches (*Coccothraustes vulgaris*), British, deposited.

OUR ASTRONOMICAL COLUMN

THE MASS OF MERCURY.—In the *Bulletin Astronomique* for October Herr Backlund has published a new determination of the mass of Mercury deduced from the perturbations produced in the motion of Encke's comet arising from its close proximity to the planet in 1878. From the apparitions of the comet in 1871, 1875, 1878, 1881, and 1885, Herr Backlund finds the reciprocal of the mass of Mercury to be 2,668,700,—thus making the mass of the planet considerably larger than has been found by recent investigators. And Herr Backlund states that, even supposing the acceleration of the comet's mean motion to have been constant during the entire period 1871–85, it is not possible to represent satisfactorily the five apparitions of the comet during that period on the assumption that the reciprocal of the mass of Mercury is greater than 5,000,000.

THE NATAL OBSERVATORY.—Mr. Neison has issued his Report, as Superintendent of the Natal Observatory, for the year 1885. The staff of the Observatory consists of the Government Astronomer, an Astronomieal Assistant, and a Meteorological Assistant. Four ladies have also been employed during the year as astronomical computers. The equatorial appears to have been but little used in 1885, all the astronomical observations recorded having been made with the 3-inch transit. The total number of observations made with this instrument was 706, including transits of stars, of the sun, of the moon's limb, of the lunar crater Murchison A, and observations of zenith stars for latitude. With regard to the latter class of observations, it is proposed to determine the latitude of the Observatory with the greatest care, as one of the primary points of the geodetic triangulation of South Africa. Forty pairs of stars have been selected for this purpose, mostly differing in zenith distance by not more than 3′ or 4′. Also, with the view of better connecting the fundamental declinations of the star catalogues of northern and southern observatories, arrangements have been made for comparing, by Talcott's method, the zenith distances of a number of southern circumpolar stars with suitably placed northern stars of corresponding zenith distance. A list of thirty-two stars has been prepared for this purpose. Mr. Neison also reports on the state of his own work on the lunar theory, which he appears to consider of an official character.

COMET FINLAY (1886 *e*).—The following ephemeris of this object is by Dr. A. Krueger (*Astr. Nachr.*, No. 2755):—

For Berlin Midnight

1886	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Nov. 28	21 0 50	19 10·7 S.	9·9941	9·9142	3·0
30	21 10 58	18 20·4			
Dec. 2	21 21 12	17 27·2	9·9971	9·9060	3·1
4	21 31 30	16 31·0			
6	21 41 53	15 31·9	0·0016	9·8992	3·1
8	21 52 20	14 30·0			
10	22 2 49	13 25·6 S.	0·0074	9·8941	3·1

The brightness at date of discovery is taken as unity.

COMET BARNARD (1886 *f*).—The following ephemeris of this object for Berlin midnight is by Dr. Oppenheim (*Dun Echt Circular*, No. 130):—

1886	R.A. h. m. s.	Decl. ° ′	log r	log Δ	Brightness
Nov. 27	14 34 10	16 50·4 N.	0·0029	9·8864	17·8
29	14 54 42	17 23·5			
Dec. 1	15 16 12	17 46·0	9·9879	9·8640	21·2
3	15 38 23	17 56·0			
5	16 0 54	17 51·8	9·9839	9·8448	23·6
7	16 23 24	17 33·0			
9	16 45 27	17 0·1 N.	9·9920	9·8303	24·3

The brightness at date of discovery is taken as unity.

GORE'S NOVA ORIONIS.—It seems to be clearly established that this interesting star is indeed—as was from the first suspected from the character of its spectrum—a simple variable, and not one of the class to which the title "temporary" can be fitly applied. M. Dunér, who had observed the star at intervals from last December to the end of April, found (*Astr. Nachr.*, No. 2755), on renewing his observations at the end of October and the beginning of the present month, that it had unmistakably increased in brightness in the interval, and was continuing to do so. Herr Fr. Schwab and Mr. Espin confirm this conclusion, the former having observed this star early in last July, and found it then fainter than the 12th magnitude. Its period would appear to be not far from one year; Herr Schwab gives it as one or two weeks longer than a year, and as ranging in brightness from 6m. to 12½m., whilst M. Dunér assigns a period of 359·5d. to it. It is clearly of importance that it should be carefully watched during the coming winter.

ASTRONOMICAL PHENOMENA FOR THE WEEK 1886 *NOVEMBER* 28—*DECEMBER* 4

(For the reckoning of time the civil day, commencing at Greenwich mean midnight, counting the hours on to 24, is here employed.)

At Greenwich on November 28

Sun rises, 7h. 42m.; souths, 11h. 48m. 10·4s.; sets, 15h. 55m.; decl. on meridian, 21° 21′ S.: Sidereal Time at Sunset, 20h. 25m.

Moon (three days after New) rises, 9h. 52m.; souths, 14h. 15m.; sets, 18h. 39m.; decl. on meridian, 19° 7′ S.

Planet	Rises	Souths	Sets	Decl. on meridian
	h. m.	h. m.	h. m.	° ′
Mercury	8 40	12 35	16 30	23 11 S.
Venus	7 33	11 43	15 53	20 51 S.
Mars	10 27	14 14	18 1	24 15 S.
Jupiter	3 55	9 12	14 29	9 14 S.
Saturn	19 5*	3 7	11 9	21 25 N.

* Indicates that the rising is that of the preceding evening.

Occultation of Star by the Moon (visible at Greenwich)

Dec.	Star	Mag.	Disap.	Reap.	Corresponding angles from vertex to right for inverted image
			h. m.	h. m.	° °
3	h^1 Aquarii	5½	17 8	18 30	116 286

Dec.	h.	
3	5	Venus in superior conjunction with the Sun.
3	12	Mercury in inferior conjunction with the Sun.
4	4	Mercury at least distance from the Sun.

Variable Stars

Star	R.A.	Decl.		h. m.	
	h. m.	° ′			
U Cephei	0 52·2	81 16 N.	Nov. 28,	2 27	*m*
			Dec. 3,	2 6	*m*
Algol	3 0·8	40 31 N.	,, 1,	5 38	*m*
			,, 4,	2 27	*m*
ζ Geminorum	6 57·4	20 44 N.	Nov. 29,	0 0	*m*
			Dec. 4,	0 0	*M*
U Monocerotis	7 25·4	9 32 S.	Nov. 28,		*m*
S Cancri	8 37·4	19 27 N.	,, 28,	3 9	*m*
T Ursæ Majoris	12 31·2	60 7 N.	,, 29,		*M*
S Virginis	13 27·1	6 37 S.	,, 30,		*M*
β Lyræ	18 45·9	33 14 N.	,, 28,	21 30	*m*
			Dec. 2,	5 0	*m*
R Lyræ	18 51·9	43 48 N.	Nov. 28,		*M*
η Aquilæ	19 46·7	0 43 N.	Dec. 1,	2 30	*M*
δ Cephei	22 24·9	57 50 N.	Nov. 30,	2 0	*m*

M signifies maximum; *m* minimum.

Meteor Showers

The chief shower of the week is that of the *Taurids*; R.A. 60°, Decl. 49° N. Other radiants active at this time are as follows:—Near η Persei, R.A. 44°, Decl. 56° N., slow, faint meteors; near α Canum Venaticorum, R.A. 194°, Decl. 43° N., very swift, streak-leaving meteors; from Leo Minor, R.A. 155°, Decl. 36° N.; from near η Ursæ Majoris, R.A. 208°, Decl. 43° N. Fireball dates, November 29 and December 2.

TEN YEARS' PROGRESS IN ASTRONOMY[1]

II.

The Solar Spectrum.—In 1877 Dr. Henry Draper, of New York, by a series of most laborious, time-consuming, and expensive researches, discovered the presence of oxygen in the sun, evidenced in his photographs, not by fine dark lines, as in the case of elements previously recognised, but by bright, hazy bands. It is difficult to assign any reason why this gas should behave so peculiarly and so differently from others, and for this reason many high authorities are indisposed to accept the discovery. But the evidence of the photographs seems fairly to outweigh any such purely negative theoretical objections.

Other advances have been made in the study of the spectrum, due mainly to the great improvements in spectroscopic apparatus. Until recently it has not been easy to decide with certainty as to some lines in the spectrum whether they were of solar or telluric origin; the great bands known as A and B, for instance. It was only in 1883 that the Russian, Egoroff, succeeded in proving that these are produced by the oxygen in the earth's atmosphere. In his experiments, on a scale previously unknown, the light was transmitted through tubes more than 60 feet in length, closed at the end with transparent plates, and filled with condensed gas.

It was quite early pointed out that the sun's rotation ought to produce a shift in the position of lines in the spectrum according as the light is derived from the advancing or receding edge of the solar disk, and Zollner thought he could perceive it. The earliest *measures*, however, were, I believe, those obtained independently by Vogel and the writer in 1876. In the great bisulphide of carbon spectroscope of Thollon the displacement becomes easy of observation; and very recently Cornu, by taking advantage of it, and by an extremely ingenious arrangement for making a small image of the sun to oscillate across the spectroscope slit two or three times a second, has been able to discriminate at a glance between the telluric and solar lines; the former stand firm and fast, while the latter seem to wave back and forth.

In this connection also should be mentioned the great map of the solar spectrum, for which Thollon received the Lalande Prize of the French Academy of Sciences last January, and the still more accurate and important map photographed by Prof. Rowland, by means of his wonderful diffraction-gratings, and now in course of publication. Nor would it be just either to omit the earlier and less accurate maps of Fievez and Vogel, which, when published, were as far in advance of anything before them as they are behind the new ones; nor the maps just made by Prof. Smyth, of Edinburgh.

It was in connection with the construction of such a map by Mr. Lockyer, that he was led to his theory of the compound nature of the so-called chemical elements, partly as a result of his comparisons of the spectra of different substances with the solar spectrum, and partly in consequence of considerations drawn from certain phenomena observed in the solar and stellar spectra themselves. His first paper on the subject was read late in 1878. This "working hypothesis," as its author calls it, has met with much discussion, favourable and unfavourable. It unquestionably removes many difficulties and explains many puzzling phenomena; at the same time there are very serious objections to it, and some of the arguments upon which Mr. Lockyer originally laid much stress have turned out unsound. For instance, he made a great point of the fact that, after all precautions are taken to remove impurities, several elementary substances show in their spectra common lines—"basic lines" he called them—indicating, as he thought, a common component. He found in the solar spectrum about seventy of these "basic lines." Now, under the high dispersion of our newer spectroscopes, these lines, which were single to his instruments, almost without exception dissolve into pairs and triplets, and withdraw their support from his theory.

I suppose that at present the weight of scientific opinion is against him; but, for one, I do not believe his battle is lost. In view of the law of Dulong and Petit, which establishes a relation between the atomic weight and specific heat of bodies, it seems to be pretty certain that *hydrogen* cannot be the elementary "*urstoff*" out of which all other elements are made by building up, as he at first seemed disposed to maintain; this element stands apparently on no different footing from the rest. But I see no reason why the elements, as we know them, may not constitute one *class* of bodies by themselves, all built up out of some as yet more elemental substance or substances. The "periodic law" of Mendelejeff suggests such a relation. And our received theories so stumble, hesitate, and falter in their account of many of the simplest phenomena of the solar and stellar atmospheres, that a strong presumption still remains in favour of the new hypothesis. I am not prepared to accept it yet; but certainly not to reject it.

The Chromosphere.—The study of the chromosphere and prominences has been kept up, very systematically and statistically, by Tacchini in Italy, and with less continuity, but still assiduously, by several other observers. I do not know, however, that any new results of much importance have been arrived at. The list of bright lines visible in their spectra has been a good deal enlarged; and Trouvelot thinks he has observed *dark* prominences—objective forms that show, black but active, upon the background of bright scarlet hydrogen in the surrounding chromospheric clouds. It may be that he is right; but, so far

[1] "Ten Years' Progress in Astronomy, 1876-86," by Prof. C. A. Young. Read May 17, 1886, before the New York Academy of Sciences. Continued from p. 69.

as I can learn, no other observer of the solar atmosphere has seen anything similar. I certainly have not myself. And I think some of his published observations of velocities of two or three thousand miles a second in the motions of the prominences, as evidenced by the displacement of lines in the spectrum, are still more questionable.

In two or three cases, prominences have been observed since 1876 considerably higher than any known previously. In October 1878 I myself observed one which attained an elevation of nearly 400,000 miles (13½′).

Eclipses and the Corona.—The sun's corona has been, perhaps, more earnestly studied than anything else about the central luminary, especially during the four eclipses which have occurred since 1876. At the eclipse of 1878, in the midst of an epoch of sunspot quiescence, the corona was found less brilliant than ordinary, and especially deficient in the unknown gas that produces the so-called 1474 line—the line which characterises the spectrum of the corona, and first demonstrated conclusively its solar origin in 1869. But while the corona at this time was less brilliant than it had been formerly, it was far more extensive. At least it seemed so; for, at Pike's Peak and Creston, Langley and Newcomb were able to follow its streamers to a distance of 6° from the sun. It is possible, however, that this extension was only due to the superior transparency of the mountain air.

The Egyptian eclipse of 1882 gave us some interesting results respecting the spectrum of the prominences and the corona. It appears that the light of the corona is especially rich in the ultra-violet, and in the photographs of the spectrum a number of bands are found which have been interpreted, with questionable correctness I think, as indicating the presence of carbon. The eclipse of 1883 was observed in the Pacific Ocean by French and American parties, but, I think, added very little real information. Prof. Hastings made an observation which he believed to establish a peculiar theory proposed by himself, viz. that the corona is merely a diffraction effect produced by the moon's limb, and depending on the non-continuity of phase in long stretches of light-vibrations. With a peculiar apparatus prepared expressly for the purpose, he found that at any moment the 1474 line was visible to a much greater distance from the sun on the side least deeply covered by the moon than on the other: as unquestionably would happen if his theory were correct. But the same thing would result from the mere diffusion of light by the air; and, notwithstanding his protests, the French observers who were at the same place, and nearly all others who have discussed the observations, think that this was the true explanation of what he saw. So far as I know, the discussion of the subject which has resulted from his publication has only strengthened the older view—that the corona is a true solar appendage; an intensely luminous but excessively attenuated cloud of mingled gas and fog and dust surrounding the sun, formed and shaped by solar forces.

The diffraction theory has one advantage—that it relieves us from stretching our conceptions as to the possible attenuation of matter to the extent necessary in order to account for the fact that a comet, itself mostly a mere airy nothing, experiences no perceptible retardation in passing through the coronal regions. There can be no question that this has happened several times: the last instance having been the great comet of 1882. But on careful consideration it will be found, I think, that our conceptions will bear the stretching without involving the least absurdity; a single molecule to the cubic foot would answer every necessary condition of the luminous phenomenon observed. And all the rifts and streamers, and all the radiating structure and curved details of form, cry out against the diffraction hypothesis.

The observations of the eclipse of 1885 (observed only by a few amateurs in New Zealand) have not proved important.

At present the most interesting debate upon the subject centres around the attempt of Mr. Huggins (first in 1883) to obtain photographs of the corona in full sunlight. He succeeded in getting a number of plates showing around the sun certain faint and elusive halo forms which certainly look very coronal. Plans were made and have been carried out, for using a similar apparatus on the Riffelberg, in Switzerland, and at the Cape of Good Hope. But so far nothing has been obtained much in advance of Mr. Huggins's own first results. Since September 1883, until very recently, the air has been full, as every one knows, of a fine haze, probably dust and vapour from Krakatão, which has greatly interfered with all such operations. It is now fast clearing away, and I for one am somewhat sanguine that a much greater success will be reached next winter at the Cape, and perhaps even in England during the coming summer.

Just about the same time that Huggins was photographing in England, Prof. Wright was experimenting in New Haven in a different way: isolating the blue and ultra-violet rays by the use of coloured media, stopping out the sun's disk, and receiving the image of the coronal regions on a fluorescent screen. He also had obtained what he believed, and still believes, to be a real image of the corona, when the aërial haze intervened to put an end to all such operations; for of course it is evident that whether one operates by this method or by photography, success is possible only under conditions of unusual atmospheric transparency and purity.

I suppose at present the predominant feeling among astronomers is that the case is hopeless, and that Huggins and Wright are mistaken. It may be so. But my own impression is that they are probably correct; although, of course, the matter is still in doubt.

Inferior Planets.—Leaving now the sun, and passing to the planetary system, we come first to the subject of intra-Mercurial planets.

The general opinion among astronomers (in which I fully concur) is that the question has been now fairly decided in the negative, *i.e.* it is practically certain that within the orbit of Mercury there is no planet of a diameter as large as five hundred miles, probably not one hundred. If such a one existed, it could not have failed to be discovered by the wide-angled photographs taken at the eclipses of 1882 and 1883, to say nothing of the visual observations. Of course, it is well known that at the eclipse of 1878 Prof. Watson supposed he had discovered two such bodies, and his extensive experience and his high authority led, for a time, to a pretty general acceptance of his conclusion. I notice that Dr. Ball, even very lately, in his "Story of the Heavens," is still disposed to credit the discovery. But Dr. Peters, by a masterly discussion of the circumstances of the observations themselves, and a comparison with the star maps, has shown that it is almost certain that Watson really saw only the two stars θ and ζ Cancri. In the same paper also, Peters examined all the observations of small, dark spots crossing the sun's disk which, up to that date (1879), had been made by Leverrier and others the ground for their belief in "Vulcan"; and he shows that they really afford no sufficient ground for the conclusion. As to Mr. Swift's supposed observation of two objects with large disks "both pointing to the sun," they certainly were not the two seen by Watson, while they were in the region covered by Watson and several other observers. What the precise nature of the mistake or illusion may have been it is perhaps not now possible to discover, but I think no one, unless perhaps Mr. Swift himself, now considers the observation important.

While, however, the question of a "Vulcan" is now pretty definitely settled, it is not at all impossible, or even improbable, that there may be intra-Mercurial asteroids, and that some of them may be picked up as little stars of the sixth magnitude or smaller, by the photographers at the eclipse of next August, or in 1887. The sensitiveness of our present photographic plate is now many times greater than it was even in 1882.

As to the planet Mercury, there is very little to report. It "transited" the sun in May 1878, and again in November 1881, and during the transits numerous measures were made of its diameter, giving results substantially in accord with the older values. I have already alluded, in connection with the earth's rotation, to Newcomb's investigation of former transits of this planet as establishing the sensible uniformity of the earth's rotation.

The planet Venus, by her transit in 1882, has attracted much attention, and much interest is felt as to the final outcome of the whole enormous mass of data, photographic and visual. Just how long we shall have to wait for the publication seems still uncertain. I have already said, however, that probably these transits will never again be considered as important as hitherto.

The most important physical observations upon the planet during the decade seem to be those of Langley, who, during the transit of 1882, observed a peculiar, and so far unexplained, illumination of one point on the edge of the planet's disk, and those of Trouvelot and Denning, who have observed and figured

certain surface-markings of the planet. I think I may fairly mention also our Princeton observation of the spectrum of the planet's atmosphere during the transit, and our confirmation of Gruithuisen's old observation of a white cap (likely enough an ice-cap), at the edge of the planet's disk—probably marking the planet's pole, and showing that the planet's equator has no such anomalous inclination of 50° or 60°, as stated in some of the current text-books. This cap has also been observed by Trouvelot and Denning. But this lovely planet is most refractory and unsatisfactory as a telescopic object, apparently enveloped in dense clouds which mostly hide the real surface of the globe, and mock us with a meaningless glare.

We mention in passing, but without indorsement, the speculations of Houzeau, who has attempted to account for some of the older observations of a satellite to Venus, by supposing another smaller sister planet, "Neith," circling around the sun in an orbit a little larger than that of Venus, and from time to time coming into conjunction with it. But the theory is certainly untenable; a planet large enough to show phases, as the hypothetical satellite is said to have done, in the feeble telescopes with which many of the observations were made 100 years ago or more, would be easily visible to the *naked eye even*. There can be little doubt that all the Venus satellites so far observed are simply *ghosts* due to reflections between the lenses of the telescope, or between the cornea of the eye and the eye lens.

Mars.—But while Venus has gained no moons during the past ten years, Mars has acquired two, and they are both native Americans. There is no need to recount the faithful work of Prof. Hall with the then new great telescope at Washington, and its brilliant result; brilliant in a scientific sense, that is, for, regarded as luminaries, it must be admitted that the Martial satellites, in spite of their formidable names of Phobos and Deimos, do not amount to much. Under the best of circumstances, they are too faint to be seen by any but keen eyes at the end of great telescopes. Small as they are, however, the little creatures punctually pursue the orbits which Hall has computed for them, and, when the planet came to its opposition a few weeks ago, they were found just in their predicted places. They are interesting, too, from the light they throw upon the genesis and evolution of the planetary system, almost compelling the belief that they have come *gradually* into their present relation to the planet. The inner one, Phobos, revolves around the primary in 7h. 39m., which is less than one-third of the planet's day. The theory of "tidal evolution," proposed by Prof. G. H. Darwin in 1878-80, as the result of his investigations upon the necessary mechanical consequence of the tidal reactions between the earth, sun, and moon, will account for Phobos, and I know nothing else that will; though, of course, it would be rash to assert that no other account can ever be given.

Much attention has also been paid to the study of the planet's surface. In 1876 we were already in possession of three elaborate maps, by Proctor, Kaiser, and Terby, agreeing in the main as to all the characteristic formations. In 1877, Schiaparelli, of Milan, detected, or thought he did, on the planet's surface, a numerous system of "canals"—long, straight channels, some of them more than 1000 miles in length, with a pretty uniform width of fifty or sixty miles; and from his observations he constructed a new map, differing from the older ones somewhat seriously, though still accordant in the most essential features. His nomenclature of the seas and continents, derived from ancient geography, is certainly a great improvement on that of his predecessors, who had affixed to them the names of their friends and acquaintances among living astronomers. There has been some scepticism as to the reality of these "canals"; but in 1879 and 1881 they were all recovered by Schiaparelli, and several other observers, notably Burton, also made them out. Moreover, Terby finds, from drawings in his possession, that they had before been seen, though not understood or clearly recognised, by Dawes, Secchi, and other observers. At present the balance of evidence is certainly in their favour, especially as the observers at Nice report seeing them last spring. I do not think the same can be said in respect to another observation of Schiaparelli's on the same object, made in 1881. He then found nearly all of these canals—more than twenty of them—to be *double*, *i.e.* in place of a single canal there were two—parallel, and 200 or 300 miles apart. No one else so far has confirmed this "gemination" of the canals; but the planet does not come to a really favourable opposition again until 1890 and 1892, when probably the question can be settled.

The time of rotation has during the past year been determined with great accuracy by Bakhuyzen, who has corrected some errors of Kaiser and Proctor, and finds it 24h. 37m. 22·66s. In 1876 there still remained some question as to the amount by which the planet is flattened at the poles. The majority of observers had found a difference between equatorial and polar diameters amounting to between 1/100 and 1/30, while, on the other hand, a few of the best observers had found it insensible. The writer, in 1879, made a very careful determination, and found it 1/219, a quantity closely agreeing with the theoretical value deduced by Adams as probable from the motion of the newly-discovered satellites.

The Asteroids.—On May 1, 1876, the number of known asteroids was 163. To-day it stands at 258, 95 of these little bodies having been discovered within the decade, 45 of them by one man, Palisa, of Vienna, while our own Peters is responsible for 20.

None of the new ones are especially remarkable, *i.e.* some of the older ones are always more so; the most inclined and most eccentric orbits, the longest and the shortest periods, none of them belong to any of the late discoveries. One point is noteworthy, that the more recently discovered bodies are much smaller than the earlier ones. The first 25, discovered between May 1876 and October 1878, have an average opposition magnitude of 11·2, while the last 25, discovered since April 1883, average only 12·2; *i.e.* the first 25 average about 2½ times as bright as the last. Out of the whole 95, two are of the 9th magnitude (one of them, No. 234, was discovered as recently as August 1883), 14 are of the 10th, 33 of the 11th, 33 of the 12th, and 13 of the 13th. Of these last 13, 10 have been found within the past two years; and of the 12 others found in the same time, 6 are of the 11th magnitude, and 6 of the 12th.

It is clear that there can remain very few to be discovered as large as the 10th magnitude, but there may be an indefinite number of the smaller sizes.

The Major Planets.—As regards the planet Jupiter, the one interesting feature for the past ten years has been "the great red spot." This is an oval spot, some 30,000 miles in length, by 6000 or 7000 in width, which first attracted attention in 1878. At first, and for three years, it was very conspicuous, but in 1882 it became rather faint, though still remaining otherwise pretty much unchanged. In 1885 it was partly covered with a central whitish cloud, which threatened to obscure it entirely; but this season the veiling cloud has diminished, and the marking is again as plain as it was in 1882 or 1883. How long it will continue, no one can say; nor is there any general and authoritative agreement among astronomers as to its nature and cause.

In connection with observations upon this object, several new determinations have been made of the planet's rotation-period, and they all show that, as in the case of the sun, the equatorial markings complete the circuit more rapidly than in higher latitudes; a white spot near the equator gives 9h. 50m. 6s., as against 9h. 55m. 36s. for the red spot, which is approximately in latitude 30°.

We must not omit to mention Prof. Pickering's new photometric method of observing the eclipses of this planet's satellites. Instead of contenting himself with observing merely the moments of their disappearance and reappearance—an observation not susceptible of much accuracy—he makes a series of rapid comparisons between the brightness of the waning or waxing point of light during the two or three minutes of its change, using, as the standard, one of the neighbouring uneclipsed satellites. From these comparisons he determines the moment when the satellite under eclipse has just half its normal brightness, and this with a probable error hardly exceeding a single second, while the old-fashioned method gave results doubtful by not less than a quarter of a minute. Cornu and Obrecht have independently introduced the same method at Paris. When we have a complete twelve years' series of such observations, they will give an exceedingly precise determination of the time required by light to traverse the earth's orbit, and so, indirectly, of the solar parallax.

As regards Saturn, there is nothing to report so startling as Jupiter's red spot. A white spot, which appeared in 1877, enabled Hall to make a new determination of the rotation-period, which came out 10h. 14m. 14s. This is in substantial

accord with an earlier determination of W. Herschel's (10h. 16m. 7s.), but involves a serious correction of the value 10h. 29m. 17s. given in most of the text-books. The error probably came from a servile copying of a slip of the pen made by some book-compiler, fifty years ago or more, in accidentally writing Herschel's value of the rotation of the inner ring, instead of that of the planet.

Much time has been spent in observations of the rings, and Trouvelot has reported a number of remarkable phenomena, most of which, however, he alone has seen as yet. The most recent micrometric measures have failed to confirm Struve's suspicion that the rings are contracting on the planet. Extensive series of observations have been made upon the satellites by H. Struve, Meyer, and others in Europe, and by Hall in this country. Hall's observations are especially valuable, and the series is now so nearly completed that we may soon hope to have most accurate tables. In the case of Hyperion, there is found a singular instance of a *retrograde* motion of the line of apsides of the orbit, produced by the action of an *outside* body, the effect being due to the near commensurability of the periods of Hyperion and Titan. This most peculiar and paradoxical disturbance first showed itself as an observed fact in Hall's observations; and, soon after, Newcomb gave the mathematical explanation and development. He finds the mass of Titan to be about 1/12,500 that of Saturn. It may be noted, too, that Hall's observations of the motions of Mimas and Enceladus indicate for the rings a mass less than 1/10 that deduced by Bessel: instead of being 1/100 as large as the planet, they cannot be more than 1/1000, and are probably less than 1/10,000.

The satellites of Uranus have also been assiduously observed at Washington, so that at present the Uranian system is probably as accurately determined as the Jovian, perhaps more so. The form of the planet has been shown to be decidedly elliptical (about 1/14) by observations of Schiaparelli and at Princeton; and the same observers have detected faint belts upon the disk, which have also been seen at Nice, and by the Henrys in Paris. Many of the observations appear to indicate a very paradoxical fact—that the belts, and consequently the planet's equator, are inclined to the orbits of the satellites at a considerable angle. The mathematical investigations of Tisserand appear to demonstrate that, in the case of a planet perceptibly flattened at the poles, satellites near enough to be free from much solar disturbance must revolve nearly in the plane of the equator; while those more remote, and disturbed more by the sun than by the protuberant equator of the planet, must revolve nearly in the plane of the planet's orbit. Thus the two satellites of Mars, the four satellites of Jupiter, and the seven inner satellites of Saturn, all move nearly in the equatorial plane, while our moon and Japetus move in ecliptical orbits. It is very difficult to believe that the satellites of Uranus, which are certainly not ecliptical and are very near the planet, do not move equatorially. And yet it is unquestionable that most of the observations with sufficiently powerful telescopes (my own among them) do seem to indicate pretty decidedly that the planet's equator is inclined as much as 15° or 20° to the orbit plane of the satellites.

As to Neptune, there is nothing new. One or two old observations of the planet have turned up in the revision of old star catalogues, and Hall, of Washington, has made a careful and accurate determination of the orbit of its one satellite, and of the planet's mass; while Maxwell Hall, of Jamaica, has deduced a very doubtful value of the planet's rotation from certain photometric observations of its brightness.

There has been some hope that a planet beyond Neptune might be found. Guided by certain slight indications of systematic disturbances in the motion of Neptune, Todd made an extended search for it in 1877-78, using the Washington telescope, and hoping to detect it by its disk, but without results. If such a planet exists, it is likely to appear as a star between the 11th and 13th magnitude, and may be picked up any time by the asteroid-hunters. But its slow motion, and the fact that our present charts give but few stars below the $11\frac{1}{2}$ magnitude, will render the recognition difficult.

The indications I have spoken of, and certain others first noted in 1880 by Prof. G. Forbes, and depending upon the behaviour of certain periodic comets, furnish pretty strong reasons for believing in its existence, though as yet they fall far short of making it certain.

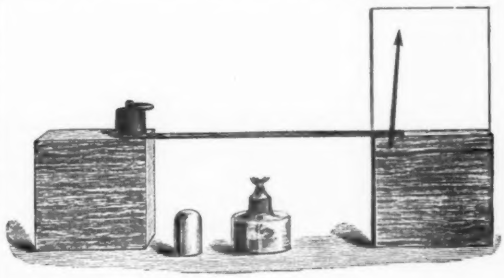
(*To be continued.*)

A LECTURE EXPERIMENT ON THE EXPANSION OF SOLIDS BY HEAT

I VENTURE to call attention to a simple and effective way of demonstrating the linear expansion of solids when heated, first suggested, I believe, by M. Kapoustine (*Journal de Physique*, December 1883, p. 576). It answers at least as well as the system of levers known as "Ferguson's pyrometer," which is usually employed for the purpose, while the cost of the apparatus is almost nothing, and any one can make it in ten minutes.

The principle is, to magnify the slight extension of a bar by causing the end of it to roll upon a needle, and thus turn the latter round and move a pointer attached to it through a sensible arc.

The figure given below will show the nature of the apparatus.



A small flat rod of the material to be examined, such as brass, iron, or glass, about 30 cm. long, 1 cm. broad, and 2 or 3 mm. thick, is laid upon two wooden blocks, placed about 25 cm. apart. A weight is put upon one end of the rod to keep it from moving; under the other end, at right angles to the length of the rod, is laid a fine sewing-needle, to the eye-end of which a light pointer of straw, about 16 or 20 cm. long, is attached by sealing-wax. Behind the pointer (which is painted black) a screen of white cardboard is fixed on the wooden block by drawing-pins.

When the rod is heated by a lamp-flame, the free end of it, as it expands, moves forward upon the needle and rolls it round, its movement being shown by the motion of the pointer. Even the slight expansion of a slip of glass is thus easily rendered evident to a class.

I have constructed for my own use a double apparatus on the same principle, in which the surfaces between which the needle rolls are of brass, ground true and flat. Two bars of different materials lie side by side, each having its own bit of needle and aluminium pointer, ranging over the same scale. They are heated equally by a broad flame (spirits of wine in a wide trough) and the difference of expansibility as well as the fact of expansion by heat is thus shown.

It is advisable to counterpoise the pointer by putting a shot or two into the lower end of the straw which projects below the needle, and cementing them in by sealing-wax. Also, before the experiment is shown to an audience, it is well to make sure that the needle rolls fairly and freely between the bar and the block. Such precautions, however, are not in the slightest degree necessary for school-work; for there is always one thing which gives the typical boy greater pleasure than to see an experiment succeed, and that is—to see it fail.

Eton College H. G. MADAN

COMPARATIVE STUDIES UPON THE GLACIATION OF NORTH AMERICA, GREAT BRITAIN, AND IRELAND[1]

OBSERVATIONS extending over several years upon glacial phenomena on both sides of the Atlantic had convinced the author of the essential identity of these phenomena; and the object of this paper was to show that the glacial deposits of Great Britain and Ireland, like those of America, may be interpreted most satisfactorily by considering them with reference to a series of great *terminal moraines*, which both define confluent

[1] Abstract of a Paper read at the Birmingham meeting of the British Association, September 1886, by Prof. H. Carvill Lewis, M.A., F.G.S.

lobes of ice and also often mark the line separating the glaciated from the non-glaciated areas.

The paper began with a sketch of recent investigations upon the glaciation of North America, with special reference to the significance of the terminal moraines discovered within the last few years. The principal characters of these moraines were given, and a map was exhibited showing the extent of the glaciated areas of North America, the course of the interlobate and terminal moraines, and the direction of striation and glacial movement. It was shown that, apart from the great ice sheet of North-Eastern America, an immense lobe of ice descended from Alaska to Vancouver's Island on the western side of the Rocky Mountains, and that from various separate centres in the Cascade, Sierra Nevada, and Rocky Mountains there radiated smaller local glaciers.

The mountains encircling the depression of Hudson Bay seemed to be the principal source of the glaciers which became confluent to form the great ice-sheet. In its advance, this ice-sheet probably met and amalgamated with a number of already existing local glacial systems, and it was suggested that there was no necessity for assuming either an extraordinary thickness of ice at the Pole, or great and unequal elevations and depressions of land.

Detailed studies made by the author in Ireland in 1885 had shown remarkably similar glacial phenomena.

The large ice-sheet which covered the greater part of Ireland was composed of confluent glaciers, while distinct and local glacial systems occurred in the non-glaciated area. The principal ice-sheet resembled that of America in having for its centre a great inland depression surrounded by a rim of mountains.

These appear to have given rise to the first glaciers, which, after uniting, poured outwards in all directions. Great lobes of this ice-sheet flowed westward out of the Shannon and out of Galway, Clew, Sligo, and Donegal Bays, northward out of Loughs Swilly and Foyle, and south-eastward out of Dundalk and Dublin Bays; while to the south the ice-sheet abutted against the Mullaghareirk, Galty, and Wicklow Mountains, or died out in the plains.

Whether it stopped among the mountains or in the lowlands, its edge was approximately outlined by unusual accumulations of drift and boulders, representing the terminal moraines. As in America, this outer moraine was least distinct in the lowlands, and was often bordered by an outer "fringe" of drift several miles in width.

South of an east and west line extending from Tralee to Dungarvan is a non-glaciated zone free from drift. Several local systems of glaciers occur in the South of Ireland, of which by far the most important is that radiating from the Killarney Mountains, covering an area of 2000 square miles, and entitled to be called a local ice-sheet. Great glaciers from this Killarney ice-sheet flowed out of the fjord-like parallel bays which indent the south-western coast of Ireland. At the same time the Dingle Mountains, the Knockmealdown and Comeragh Mountains, and those of Wexford and Wicklow furnished small separate glaciers, each sharply defined by its own moraine.

No evidence of any great marine submergence was discovered, although the author had explored the greater part of Ireland, and the eskers were held to be phenomena due to the melting of the ice and the circulation of sub-glacial waters. The Irish ice-sheet seemed to have been joined at its north-eastern corner by ice coming from Scotland across the North Channel. All the evidence collected indicates that a mass of Scotch ice, reinforced by that of Ireland and England, filled the Irish Sea, over-riding the Isle of Man and Anglesey, and extending at least as far south as Bray Head, south of Dublin. A map of the glaciation of Ireland was exhibited in which the observations of the Irish geologists and of the author were combined, and in which was shown the central sheet, the five local glacial systems, all the known striæ, and the probable lines of movement as indicated by moraines, striæ, and the transport of erratics.

The glaciation of Wales was then considered. Wales was shown to have supported three distinct and disconnected local systems of glaciers, while at the same time its extreme northern border was touched by the great ice-lobe filling the Irish Sea. The most extensive local glaciers were those radiating from the Snowdon and Arenig region, while another set of glaciers radiated from the Plinlimmon district and the mountains of Cardiganshire, and a third system originated among the Brecknockshire Beacons. The glaciers from each of these centres transported purely local boulders and formed well-defined terminal moraines. The northern ice-lobe, bearing granite boulders from Scotland and shells and flints from the bed of the Irish Sea, invaded the northern coast, but did not mingle with the Welsh glaciers. It smothered Anglesey and part of Carnarvonshire on the one side and part of Flintshire on the other, and heaped up a terminal moraine on the outer flanks of the North Welsh mountains. This great moraine, filled with far-travelled northern erratics, is heaped up in hummocks and irregular ridges, and is in many places as characteristically developed as anywhere in America. It has none of the characters of a sea-beach, although often containing broken shells brought from the Irish Sea. It may be followed from the extreme end of the Lleyn Peninsula (where it is full of Scotch granite erratics), in a north-easterly direction through Carnarvonshire past Moel Tryfan and along the foot of the mountains east of Menai Strait to Bangor, where it goes out to sea, re-appearing further east at Conway and Colwyn. It turns south-eastward in Denbighshire, going past St. Asaph and Halkin Mountain. In Flintshire it turns southward, and is magnificently developed on the eastern side of the mountains, at an elevation of over 1000 feet, between Minera and Llangollen, south-west of which place it enters England. There is evidence that, where the ice-sheet abutted against Wales, it was about 1350 feet in thickness. This is analogous to the thickness of the ice-sheet in Pennsylvania, where the author had previously shown that it was about 1000 feet thick at its extreme edge, and 2000 feet thick at points some 8 miles back from its edge. The transport of erratics coincides with the direction of striæ in Wales as elsewhere, and is at right angles to the terminal moraine.

The complicated phenomena of the glaciation of England, the subject of a voluminous literature and discordant views, had been of high interest to the author, and had led him to redouble his efforts for its solution. He had found that it was possible to accurately map the glaciated areas, to separate the deposits made by land ice from those due to icebergs or to torrential rivers, and to trace out a series of terminal moraines both at the edge of the ice-sheet and at the edge of its confluent lobes. Perhaps the finest exhibition of a terminal moraine in England is in the vicinity of Ellesmere, in Shropshire. A great mass of drift several miles in width, and full of erratics from Scotland and from Wales, is here heaped up into conical hills which inclose "kettle holes" and lakes, and have all the characters of the "kettle-moraine" of Wisconsin. Like the latter, the Ellesmere moraine here divides two great lobes of ice, one coming from Scotland, the other from Wales. This moraine may be traced continuously from Ellesmere eastward through Madeley, Macclesfield, to and along the western flank of the Pennine Chain, marking throughout the southern edge of the ice-sheet of northern England. From Macclesfield the same moraine was traced northward past Stockport and Staleybridge to Burnley, and thence to Skipton in Yorkshire. North-east of Burnley it is banked against the Boulsworth Hills up to a height of 1300 feet in the form of mounds and hummocks. South and east of this long moraine no signs of glaciation were discovered, while north and west of it there is every evidence of a continuous ice-sheet covering land and sea alike. The striæ and the transport of boulders agree in proving a southerly and south-easterly direction of ice-movement in Lancashire and Cheshire.

From Skipton northward the phenomena are more complicated. A tongue of ice surmounted the watershed near Skipton, and protruded down the valley of the Aire as far as Bingley, where its terminal moraine is thrown across the valley like a great dam, reminding one of similar moraine dams in several Pennsylvania valleys. A continuous moraine was traced around this Aire glacier. Another great glacier, much larger than this, descended Wensleydale and reached the plain of York. The most complex glacial movements in England occurred in the mountain region about the Nine Standards, where local glaciers met and were overpowered by the greater ice-sheet coming down from Cumberland. The ice-sheet itself was here divided, one portion going southward, the other in company with local glaciers and laden with the well-known boulders of "Shap granite" being forced eastward across Stainmoor Forest into Durham and Yorkshire, finally reaching the North Sea at the mouth of the Tees. The terminal moraine runs eastward through Kirkby Ravensworth, toward Whitby, keeping north of the Cleveland Hills, and all Eastern England south of Holderness appears to be non-glaciated. On the other hand, all England north of Stainmoor Forest and the River Tees, except the very highest points, was smothered in a sea of solid ice.

There is abundant evidence to prove that the ice-lobe filling the Irish Sea was thicker towards its axis than at its edges, and at the north than at its southern terminus, and that it was reinforced by smaller tributary ice-streams from both England and Ireland. It may be compared with the glacier of the Hudson River Valley in New York, each having a maximum thickness of something more than 3000 feet. The erosive power of the ice-sheet was found to be extremely slight at its edge, but more powerful farther north, where its action was continued for a longer period. Towards its edge its function was to fill up inequalities rather than to level them down. It was held that most glacial lakes are due to an irregular dumping of drift, rather than to any scooping action, observations in England and in Switzerland coinciding with those in America to confirm this conclusion. Numerous facts on both sides of the Atlantic indicate that the upper portion of the ice-sheet may move in a different direction from its lower portion. It was also shown that a glacier in its advance had the power of raising stones from the bottom to the top of the ice, a fact due to retardation by friction of its lower layers. The author had observed the gradual upward passage of sand and stones in the Grindelwald glacier, and applied the same explanation to the broken shells and flints raised from the bed of the Irish Sea to the top of Moel Tryfan, to Macclesfield, and to the Dublin mountains.

The occurrence of stratified deposits connected with undoubted moraines, was shown to be a common phenomenon, and instances of stratified moraines in Switzerland, Italy, America, and Wales, were given. The stratification is due to waters derived from the melting ice, and is not proof of submergence.

It was held that, notwithstanding a general opinion to the contrary, there is no evidence in Great Britain of any marine submergence greater than about 450 feet. It was to be expected that an ice-sheet advancing across a sea-bottom should deposit shell-fragments in its terminal moraine. The broad principle was enunciated that wherever in Great Britain marine shells occur in glacial deposits at high levels, it can be proved both by striæ and the transport of erratics that the ice advanced on to the land from out of the sea. The shells on Three Rock Mountain near Dublin, and in North Wales and Macclesfield, all from the Irish Sea; the shells in Cumberland transported from Solway Firth; those on the coast of Northumberland brought out of the North Sea; those at Airdrie in Scotland, carried eastward from the bottom of the Clyde; and those in Caithness from Moray Firth, were among examples adduced in proof of this principle. The improbability of a great submergence not leaving corresponding deposits in other parts of England was dwelt upon.

It was also held that there was insufficient evidence of more than one advance in the ice-sheet, although halts occurred in its retreat. The idea of successive elevations and submergences with advances and retreats of the ice was disputed, and the author held that much of the supposed inter-glacial drift was due to sub-glacial waters from the melting ice.

The last portion of the paper discussed the distribution of boulders, gravels, and clays south of the glacial area. Much the greater part of England was believed to have been uncovered by land ice. The drift deposits in this area were shown to be the result in part of great fresh-water streams issuing from the melting ice-sheet and in part of marine currents bearing icebergs during a submergence of some 450 feet. The supposed glacial drift about Birmingham and the concentration of boulders at Wolverhampton were regarded as due to the former agent, while the deposits at Cromer and the distribution of Lincolnshire chalk across Southern England were due to the latter. The supposed esker at Hunstanton was held to be simply a sea-beach, and the London drift deposits to be of aqueous origin. Thus the rival theories of floating icebergs and of land glaciers were both true, the one for Middle and Southern England, the other for Scotland, Wales, and the North of England; and the line of demarkation was fixed by great terminal moraines. The paper closed with an acknowledgment of indebtedness to the many geologists in England and Ireland who had uniformly rendered generous assistance during the above investigation.

THE CLIMATE OF NORTHERN EUROPE AND THE GULF STREAM

In view of the reference made by Sir William Dawson, in his inaugural address at the meeting of the British Association, to the effect of the Gulf Stream on the climate of Northern Europe, particularly that of Norway, and the consequences of a diversion of the stream from its present course, the following contribution to the subject by the well-known Norwegian *savant*, Dr. Karl Hesselberg, which appeared in a recent number of the scientific journal *Naturen*, may be of interest and tend to its further elucidation.

According to the situation of Norway on the globe, the northern part of the country should have a distinct Polar climate, with eternal ice and snow, a home only for the Eskimo and Polar bears. Several circumstances contribute, however, to make it otherwise. The country forms a western promontory of the great Asiatic-European continent, and receives its full share of the advantages of such a situation. Mild south-west winds blow throughout the year, while warm sea-currents wash its extensive shores summer as well as winter. The winter cold is so reduced that only a small portion of the heat of the summer sun is consumed in melting the snow. The length of the summer days, too, which north of the Polar Circle last twenty-four hours, contribute to raise the mean temperature, and accelerate the growth of the flora. Certain other circumstances, as, for instance, the formation of the country and the physico-geographical conditions of the North Atlantic Ocean, contribute equally to make the Norwegian climate one of the most favourable in the world. A brief *résumé* of the circumstances will be of interest.

A chart of the distribution of the atmospheric depression in the North Atlantic Ocean—the Norwegian Sea—shows that all the year round a strong barometric minimum prevails in the middle of the sea between Norway, Iceland, Jan Mayen, and Spitzbergen, the consequence of which is that south-west winds always blow in the eastern part of this area, viz. along the coast of Norway. Warm water is thereby forced up towards Norway and Spitzbergen, even into the East Arctic Ocean. The bottom formation of the sea, too, contributes to preserve the high temperature. If a chart be examined of the depths of the North Atlantic Ocean, such a one, for instance, as is the result of Prof. Mohn's labours after the measurements of the Norwegian North Atlantic Expedition, it will be found that the sea-bottom between Norway, the Faroe Islands, Iceland, and Jan Mayen, forms a basin with a depth of a little over 2000 English fathoms. It will also be seen that the Norwegian coast does not fall abruptly into this abyss, but that the bottom along the whole coast slopes gradually down from the shore seawards to a certain point where it terminates perpendicularly. In other words, Norway is surrounded with a continuous "bank," which in a great measure contributes to preserve the high temperature along the coast. In the great basin, however, the water is icy cold at the bottom, but against this the bank forms a natural barrier, whilst above the bank the warm water is without any bottom layer of cold. It is the warm water which fills the fjords and there preserves a temperature so high that it is sometimes higher than the mean temperature of the air, and under which the fjords do not freeze, a circumstance of great importance. If the temperature of the sea-water in the winter contributes to raise the temperature of the air, it will in the summer have the opposite effect, and cause the climate to be very much tempered along the coast. It is only in the fjords and adjacent valleys that the temperature in the summer rises to a height unusual for the latitude.

In order to show the relatively favourable climate which Norway enjoys, Dr. Hesselberg supplies two diagrams. The first of these shows the mean temperature of the air over Europe and the North Atlantic Ocean in January, when it is lowest. Isotherms are shown for every fifth degree. If now, for instance, the isotherm 0°—the temperature of the air—be followed, it will at once be seen how far it shoots up northwards between Iceland and Norway, in fact, right above lat. 70° N. Instead of running east and west, it goes nearly straight north and south, particularly along the west coast of Norway, which it follows throughout its entire length, from the latitude of Tromsö to that of Christiansand. Hence it deviates towards Denmark, then runs into the Baltic, returns to Hamburg, and thence runs in a south-easterly direction across Europe, nearly down to the Adriatic Sea. Here it first trends eastwards, across Turkey and the Black Sea. Off the Norwegian coast, therefore, in lat. 70° N., the same mean temperature prevails in January as in Southern Europe in lat. 45°, and even there the mean temperature is probably 3° higher than might be expected according to the latitude. The other isotherms have a similar course, as well as the temperature at the surface of the sea. A great wave of warm water rolls up

along the coast of Norway, and may be traced even to Spitzbergen.

Another equally interesting illustration of the mildness of the winter in Norway is shown by two diagrams of the "thermal anomaly" in January. By way of comparison the month of July is included. It may be added that by thermal anomaly is meant the difference which exists between the *true* mean temperature of a place and the mean temperature *actually registered* in that latitude.

In January the thermal anomaly is very remarkable. Thus, along the coast of Norway, between the northernmost and westernmost promontories, the North Cape and Stat, it reaches + 20° C., and in the sea outside most probably + 25° C. These figures are certainly very remarkable. Eastwards, it decreases inland, but even here—where the cold is very great in the winter—it never falls below + 7°. In the Baltic, on the other hand, it again rises, as might be expected.

In the summer, however, the conditions are far from being so favourable. There is, indeed, then a narrow strip of land, on the very verge of the coast, where the thermal anomaly is slightly *negative*. The line for the 0° C. anomaly then follows the west coast, decreasing gradually seawards, whilst eastwards, across Southern Norway, it rises to + 4° C., and in Finmarken to + 70° C.

For the further elucidation of this, the following comparison of the January mean temperature in various places on the globe in about the same latitude may serve :—

About 60° *N. lat.*

	°
Hellisö Lighthouse...	2
Bergen	0
Christiania	− 5
Stockholm	− 3
St. Petersburg	− 10
Jakutsk	− 42
North Kamchatka	− 20
South Alaska	− 20
Great Slave Lake	− 25
North Coast of Labrador	− 25
Cape Farewell	− 7
Shetland Islands	4

About 71° *N. lat.*

	°
North Cape...	− 4
South Novaya Zemlya	− 20
Mouth of the Yenisei	− 34
Mouth of the Lena	− 40
Point Barrow	− 30
Boothia	− 32
Upernivik	− 20
Jan Mayen	− 10

The coldest place on the globe where the mean temperature has been *exactly* ascertained, viz. Werchojansk, in the interior of Siberia, with − 48° C. in January, lies in the same latitude as Bodö, where it is − 2° C., and Röst, with 0°·5 C.

In order to obtain correct normal values of the temperature in a place, long and continuous series of observations are necessary; and when we consider that the longest we possess for any place only extends over 100 years, and that meteorology is but a science of yesterday, the Norwegian meteorological records can make a fair show. With regard, however, to the changes which take place in the climate in a certain spot during ages—which occurrence is beyond dispute—we have no reliable data. I will only mention here Prof. Blytt's theory,[1] which has attracted many supporters, viz. that the periodical changes in the climate are due to the precession of the equinoxes (with a mean period of about 21,000 years), and to changes in the eccentricity of the earth's orbit.

It is, however, possible to accept a shorter periodical change in the climate than this, and theories on this point have not been wanting; but the only one which has found any support is the eleven-year period, corresponding to that of the sunspots, which again coincides with that of the terrestrial magnetic phenomena. It has even been attempted to bring the fall of rain and snow within a certain law, and, as some maintain, with success; but in my opinion the proofs advanced in support of such a theory are far from being conclusive.

[1] Cf. Prof. Darwin's Address to the British Association, Section A; also NATURE, vol. xxxiv. pp. 220 and 239.

TO PROVE THAT ONLY ONE PARALLEL CAN BE DRAWN FROM A GIVEN POINT TO A GIVEN STRAIGHT LINE

(1) LET OP and OQ be two lines at right angles, and let PQ move along them from O, so that OP always = OQ. Then PQ always $>$ OQ or OP.

Hence if OQ increase without limit, PQ must also do so.

Let ON bisect the angle POQ. Then N bisects PQ.

Then if OQ increase without limit, QN does so (QN = $\frac{1}{2}$ QP).

If OQ′ be taken along ON = OQ, QQ′ $>$ QN.

Hence if OQ increase without limit, QQ′ does so.

Similarly by bisecting Q′OQ by OM, we can show that QM increases without limit with OQ, and so on by continual bisection. Hence—

If two straight lines meet at any angle, the perpendicular from a point of one on the other becomes infinite when that point is at infinity.

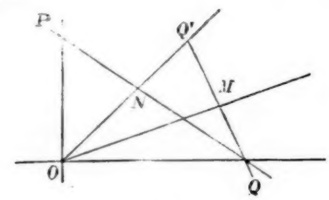


FIG. 1.

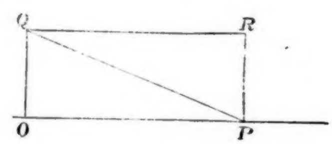


FIG. 2.

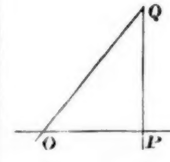


FIG. 3.

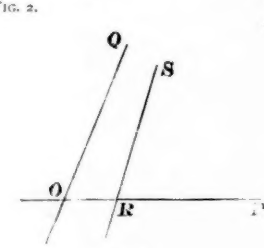


FIG. 4.

(2) Let OQ be some given length taken at right angles to a line OP;

Let PR move along OP at right angles to OP, so that PR always = OQ.

Join QR, QP.

Let OP increase without limit.

Then the angle PQR tends to become zero.

For the lines QR, PQ never become infinitely separated.

Thus there is evidently some definite position for the line QP when OP becomes ∞.

(3) Let a line PQ move at right angles to OP, so that PQ = OP.

Then if OP increase without limit, OQ increases without limit.

Hence, there is some finite angle, QOP, such that the perpendicular QP from Q at ∞ on OP falls at an infinite distance from O.

The same thing is evidently true for all angles less than QOP.

Then either it is true of all angles less than a right angle, in which case it can be easily shown that only one parallel can be drawn from a given point to a given line;

Or, there is some limiting angle, QOP, for which QP falls at ∞, and for any greater angle ($<$ right angle) QP falls at some finite distance from O.

Let Q O P be this limiting angle. Take R on O P, and draw R S to Q at ∞ along O Q.

Then if S is at ∞, the perpendicular S P falls at an infinite distance from R.

∴ Angle P R S not greater than P O Q, and it cannot be less (Eucl., I., 16 and 27).

Hence it must be equal.

Hence R S making the angle S R P = Q O P meets O Q at ∞ at both ends.

And any other straight line through R becoming infinitely distant from R S must cut O Q in some finite point.

Thus from R only one parallel, R S, can be drawn to a given line, O Q.

By moving O P along O Q always at the same angle, Q O P, we can show that

From a given point only one parallel can be drawn to a given line.

This theorem, therefore, must be true. E. BUDDEN

SCIENTIFIC SERIALS

American Journal of Science, October.—A dissected volcanic mountain; some of its revelations, by James D. Dana. Here the author returns to the subject of Tahiti, largest of the Society Islands, already described by him in 1850 from materials supplied by the Wilkes Exploring Expedition of 1839. The old cone, some 7000 feet high, is now a dissected mountain, with valleys cut profoundly into its sides, and laying bare the centre to a depth of from 2000 to nearly 4000 feet below the existing summit. As shown on the accompanying map, the valleys, due to erosion, are so crowded on one another, that the dissection is complete, thus disclosing the inner structure of a great volcanic mountain. The interior is shown to be composed, not of lava-beds, there being no horizontal lines, but of imperfect columnar formations, rising vertically in the unstratified mass quite to the summit. The uniform massiveness through so great a height at the volcano's centre is attributed to the cooling of continuously liquid lava in the region of the great central conduit of the cone. A comparative study of Mauna Loa (Hawaii), shows that such a massive central structure is a common feature of the *greater* volcanic mountains, the extremely slow cooling process under great pressure causing the lava to solidify into a *compact* crystalline rock, and often into a *coarsely crystalline* rock.—Origin of the ferruginous schists and iron ores of the Lake Superior region, by R. D. Irving. Rejecting the igneous theory, now held by few, the writer, after a careful survey of the whole field, concludes that these rocks were once carbonates analogous to those of the coal-measures, which by a process of silicification were transformed into the various kinds of ferruginous formations now occurring in this region.—Further notes on the artificial lead silicate from Bonne Terre, Montana, by H. A. Wheeler. An analysis of this interesting substance, which was found under the hearth of an old reverberatory roasting-furnace, yielded 73·66 PbO, 17·11 SiO_2, NiO 3·06 (coarse crystals), 72·93 PbO, 18·51 SiO_2, and smaller quantities of nickel, cobalt, and other ingredients.—Limonite pseudomorphs after pyrite, by John G. Meem. The paper gives a short account of the pseudomorphs occurring in Rockbridge County, Virginia, where they are associated with Lower Silurian limestones. These crystals, varying in colour from a very light to a very dark brown, and sometimes almost black, are hydrous, and yield a yellow powder, showing them to be limonite, most commonly of octahedral form.—Note on the hydro-electric effect of temper in case of steel, by C. Barus and V. Strouhal. The object of this inquiry is to determine directly the carbon relations of steel as a function of the temperature (0° to 400°, 400° to 1000°) and of the time of annealing, with full reference to the physical occurrences observed in the first and second phases of the phenomenon.—On the crystalline structure of iron meteorites, by Oliver Whipple Huntington. It is shown that the usual classification of these meteorites into octahedral and cubic crystals cannot be natural or fundamental. A careful examination of the large collection belonging to Harvard College, containing types of all the characteristic meteorites of this class, leads to the conclusion that masses of meteoric iron are cleavage crystals, broken off probably by impact with the air, and showing cleavages parallel to the planes of all three fundamental forms of the regular system (octahedron, cube, and dodecahedron); further, that the Widmanstättian figures and Neumann lines themselves are sections of planes parallel to these same forms, exhibited in every gradation from the broadest bands to the finest markings, with no natural break, the features of von Widmanstätten's figures being, moreover, due to the eliminations of impurities during the process of crystallisation.—A new meteoric iron from Texas, by W. Earl Hidden. The specimen here described and illustrated was discovered by Mr. C. C. Cusick on June 10, 1882, near Fort Duncan, Maverick County, Texas. It weighs over 97 pounds, is quite soft, being easily cut with a knife, and consists of iron 94·90; nickel and cobalt, 4·87; phosphorus, 0·25, with traces of sulphur and carbon; specific gravity, 7·522.—On pseudomorphs of garnet from Lake Superior and Salida, Colorado, by S. L. Penfield and F. L. Sperry. The Lake Superior specimen is essentially an iron alumina garnet, with formula $Fe_3Al_2Si_3O_{12}$. That of Colorado is higher in protoxides and water, the increase being perhaps due to the presence of ripidolite.—Further notes on the meteoric iron from Glorieta Mount, New Mexico, by George F. Kunz.—On the Brookite from Magnet Cove, Arkansas, by Edward S. Dana. These crystals, first described in 1846 by Shepard under the name of *arkansite*, are especially remarkable for the great variety of their forms, which is most unusual for crystals occurring in the same locality.

SOCIETIES AND ACADEMIES

LONDON

Zoological Society, November 16.—Prof. W. H. Flower, F.R.S., President, in the chair.—An extract was read from a letter addressed to the President by Dr. Emin Bey, dated Wadilai, Eastern Equatorial Africa, January 1, 1886, and containing some notes on the distribution of the Anthropoid Apes in Eastern Africa.—A letter was read, addressed to the Secretary by Dr. Chr. Lütken, of Copenhagen, F.M.Z.S., containing some information as to the locality of *Chiropodomys penicillatus*.—A letter was read from Dr. A. B. Meyer, C.M.Z.S., communicating some remarks by Mr. K. G. Henke on a specimen of a hybrid Grouse in the Dresden Museum.—Prof. Flower, F.R.S., exhibited and made remarks on a specimen of a rare Armadillo (*Tatusia pilosa*) belonging to the Scarborough Museum.—Prof. Bell exhibited, and made remarks on, an object (apparently of the nature of an amulet) made from a portion of the skin of some mammal, and received from Moreton Bay, Australia.—Mr. H. Seebohm, F.Z.S., exhibited a skin of what he considered to be a young individual of the Lesser White-fronted Goose (*Anser albifrons minutus*), shot in September last on Holy Island, off the coast of Northumberland, and observed that it was the first recorded example of the small form of the White-fronted Goose which had been obtained on the coasts of our islands.—Mr. Blanford, F.R.S., exhibited, and made remarks on, a mounted specimen of a scarce Paradoxure (*Paradoxurus jerdoni*) from the Neilgherry Hills in Southern India.—A communication was read from Colonel Charles Swinhoe, F.Z.S., containing an account of the species of Lepidopterous insects which he had obtained at Mhow, in Central India.—A communication was read from Dr. R. W. Shufeldt, C.M.Z.S., containing an account of the anatomy of *Geococcyx californianus*.—Mr. Lydekker described three crania and other remains of *Scelidotherium*, two of the former being from the Argentine Republic, and the third from Tarapaca, in Chili. One of the crania from the first locality he referred to the typical *S. leptocephalum* of Owen, while the second, which had been described by Sir R. Owen under the same name, he regarded as distinct, and proposed to call *S. bravardi*. The Tarapaca form, which was characterised by the extremely short nasals, was also regarded as indicating a new species, for which the name of *S. chilense* was proposed. The author concluded that there were not sufficient grounds for separating Lund's proposed genus *Platyonyx* from *Scelidotherium*.—Mr. G. A. Boulenger pointed out that two distinct forms of the Batrachian genus *Bombinator* occur in Central Europe, and read notes on their distinctive characters and geographical distribution.—A communication was read from Dr. R. W. Shufeldt, containing a correction, with additional notes, upon the anatomy of the *Trochili*, *Caprimulgi*, and *Cypselidæ*.—A communication was read from Dr. R. A. Philippi, C.M.Z.S., containing a preliminary notice of some of the Tortoises and Fishes of the coast of Chili.—Mr. Sclater exhibited the head of, and made remarks upon, an apparently undescribed species of Gazelle from Somali Land.

Geological Society, November 3.—Prof. J. W. Judd, F.R.S., President, in the chair.—Henry Howe Arnold-Bemrose, Richard Assheton, Francis Arthur Bather, Rev. Joseph Campbell, M.A., John Wesley Carr, Thomas J. G. Fleming, Thomas Forster, Edmund Johnstone Garwood, George Samuel Griffiths, Dr. Frederick Henry Hatch, Ph.D., Robert Tuthill Litton, Frederick William Martin, Richard D. Oldham, Forbes Rickard, Albert Charles Seward, Herbert William Vintner, and Charles D. Walcott were proposed as Fellows of the Society.—The following communications were read:—On the skull and dentition of a Triassic Saurian, *Galesaurus planiceps*, Ow., by Sir Richard Owen, K.C.B., F.R.S. The author referred to a fossil skull from the Triassic sandstone of South Africa, which combined dental characters resembling those of a carnivorous mammal with the cranial structure of a Saurian. The structure was described and figured in Owen's "Catalogue of the Fossil Reptilia of South Africa," under the generic title of *Galesaurus*, as belonging to a distinct sub-order of Reptilia termed *Theriodontia*. The characters of the skull and teeth of the original specimen of *Galesaurus* have been brought to light by further development. In both the type-specimen and that lately received, the reptilian nature of the fossil is indicated by the single occipital condyle and other features. The chief difference from a mature male of a placental or marsupial carnivore is the evidence of a primordial "gullet-tract." Further details as to the structure of the skull were given, more especially with reference to the orbits and nasals. The palatal region repeats the same general characters as in previously described Theriodonts. The angle of the jaw is not produced, as in the crocodile, beyond the articular element. In general shape and bony strength the mandible of *Galesaurus* resembles that of a mammal. The dentition is so much better preserved in the new specimen than in the type Galesaur as to call for description and illustration. In four of the upper molars the entire crown is preserved; it shows less length and greater breadth than appears in the previous restoration, is moderately curved externally, and triangular; the base is flanked by a short cusp before and behind, and the corresponding margins are finely crenulate, as in the molars of *Cynodracon*. The incisors are eight in number in both upper and lower jaws, four in each premaxillary, opposed or partially interlocking with the same number in each mandibular ramus; they have longish, slender, simple-pointed crowns. The canines, one on each side of both upper and lower jaws, have the same laniariform shape and size of crown as in the original fossil. In the right maxillary bone the long deeply-planted root is exposed; the corresponding part of the lower canine is similarly exposed in the left mandibular ramus. No trace of successional teeth, as in ordinary Saurians, has been found. Both crocodiles and alligators have two or more teeth of canine proportions; but the author shows how they differ from those of mammalian carnivores and *Galesaurus*. A similar character and disposition of destructive canines is shown by the fossil jaws of the oolitic great extinct carnivorous Saurians, *e.g.* *Megalosaurus*. In the Triassic Labyrinthodonts the destructive and prehensile laniaries would, by position, rank as incisors rather than canines. In existing lizards the dental series has more uniformity, and the cement-clad roots contract bony union with the jaw-bone. In *Galesaurus* the teeth, besides being distinguished, as in mammals, by their differential characters, are implanted freely in sockets, the cold-blooded character being chiefly manifested in the greater number of teeth following the canines, and in their want of distinction. Lastly, the author remarked on the earlier reptilian character shown by the oolitic mammal *Amphitherium*, and also by the existing Australian *Myrmecobius*. He speculates on the degree of resemblance manifested by the teeth of the old Triassic reptile of South Africa with the exceptional characters of some of the low Australian forms of mammals.—The Cetacea of the Suffolk Crag, by R. Lydekker, B.A., F.G.S. This paper commenced with notices of previous contributions to the subject by Sir R. Owen, Prof. Ray Lankester, Prof. Huxley, and Prof. Flower. In the preparation of a catalogue of the specimens in the British Museum, the author had had occasion to examine the collection of Cetacea from the Crag, not only in that Museum, but also in the Museum of Practical Geology, that of the Royal College of Surgeons, and in the Ipswich Museum, besides visiting the collections at Brussels. In consequence, several additions to the fauna, and also numerous emendations of specific names, were noticed in the paper now laid before the Society. Prof. Ray Lankester's views as to the Diestian affinities of the English-Crag Cetacea were confirmed by this comparison. Detailed notes on the specimens examined and the species identified were given.—On a jaw of *Hyotherium* from the Pliocene of India, by R. Lydekker, B.A., F.G.S. Colonel Watson, the Political Resident in Kattiawar, had recently sent to the author a fragment of a left maxilla with the three true molars, from Perim Island, in the Gulf of Cambay. The specimen belonged to *Hyotherium*, and apparently to an undescribed species, the differences between which and the several forms previously known from various European and Asiatic beds were pointed out. The author also called attention to the peculiar association of types found in the beds of Perim Island, and to the affinities of the genus *Hyotherium* with the recent *Sus* and *Dicotyles* on the one hand, and with the Upper Eocene *Chœropotamus* on the other.

Physical Society, November 13.—Prof. Balfour Stewart, President, in the chair.—In opening the proceedings, the President referred to the great loss which the Society had recently sustained by the death of Prof. Guthrie, F.R.S., the founder of the Society, and his predecessor in the chair. In the capacity of Demonstrator, Prof. Guthrie contributed materially to the success of the Society's meetings, and his decease is deeply regretted. The President also announced that the Council were considering what steps should be taken to commemorate the late Dr. Guthrie, and that a circular containing their views would be placed before the members in the course of a few days.—The following papers were then read:—On the peculiar sunrise shadows of Adam's Peak, in Ceylon, by the Hon. Ralph Abercromby, F.R.Met.Soc. The author prefaced his description by an extract from a paper on the same subject by the Rev. R. Abbay, read before the Physical Society, May 27, 1876, in which the explanation proposed is that the effects are caused by total internal reflection, as in ordinary mirage, the difference of air-density being, in this case, due to the lower temperature at high altitudes. The author pointed out that Mr. Abbay neglects the difference of density due to elevation, and that his own thermometric observations disprove conclusively any idea of mirage. The chief phenomena observed were: (1) the appearance of a circular rainbow with spectral figures near the top of the shadow of the peak; and (2) a peculiar rising of the bow and shadow, which seem to stand up in front of the observers. Both these effects are traced to the existence of mist-clouds in the vicinity of the shadow. Two dark rays or brushes were seen to shoot outwards and upwards from the circumference of the bow in directions nearly coinciding with the prolongations of the edges of the shadow, when seen projected on the lower mist-clouds, but the author does not attempt to explain this phenomenon. On one occasion a second and outer bow was seen. The times during which the phenomena were visible were too short to permit sextant observations being taken, but the diameter of the inner bow was estimated at 8° to 12°. A totally distinct kind of shadow is sometimes seen from Adam's Peak just before, and at the moment of sunrise, which seems to stand up against the distant sky. The author found a similar effect at Pike's Peak, Colorado, which is visible only at sunset. Mr. G. Griffiths remarked that he had often seen similar appearances in Switzerland. In answer to questions by the President and Prof. S. P. Thompson, the author said the reason why the shadows were seen from Adam's Peak at sunrise, and from Pike's Peak at sunset, was that the configuration of the land on the west side of the former was similar to that on the east side of the latter, both being low, whereas the opposite sides were high, and therefore unsuitable for showing the phenomena. In all cases he believed the appearances were due to the shadows being projected on clouds of suspended matter in the air at various altitudes. He had not noticed whether the colours were reversed in the second bow seen from Adam's Peak, but observed that this bow nearly, but not quite, touched the inner one.—Note on the internal capacity of thermometers, by A. W. Clayden, M.A. (Read by Prof. Reinold, Secretary.) The author proposes to determine the volume, V, of the mercury by measuring the capacity, c, of a detached piece of the same tube of known length, and thence inferring the volume of t degrees of the thermometer tube, the length of which is equal to that of the piece of tube taken. By assuming the value of a (the coefficient of *apparent* expansion of mercury in the particular kind of glass) to be known, the volume of the mercury in the thermometer can be calculated, since $c = t a V$. Prof. Rücker remarked that there were often considerable differences in the sectional area of different parts of the same tube, and hence the

method would probably not be very reliable.—On the motion of the President, a vote of condolence to Mrs. Guthrie in her sad bereavement was passed unanimously.

Royal Meteorological Society, November 17.—Mr. W. Ellis, F.R.A.S., President, in the chair.—The following were elected Fellows:—Mr. B. A. Dobson, Mr. T. Gordon, Mr. H. Mantle, Rev. J. Watson, and Mr. F. Wright.—The papers read were:—The gale of October 15–16, 1886, over the British Islands, by Mr. C. Harding, F.R.Met.Soc. The storm was of very exceptional strength in the west, south-west, and south of the British Islands, but the principal violence of the wind was limited to these parts, although the force of a gale was experienced generally over the whole kingdom. By the aid of ships' observations, the storm has been tracked a long distance out in the Atlantic. It appears to have been formed about 250 miles to the south-east of Newfoundland on the 12th, and was experienced by many ocean steamers on the 13th. When the first indication of approaching bad weather was shown by the barometer and wind at our western outposts, the storm was about 500 miles to the west-south-west of the Irish coast, and was advancing at the rate of nearly 50 miles an hour. The centre of the disturbance struck the coast of Ireland at about 1 a.m. on the 15th, and by 8 a.m. was central over Ireland. The storm traversed the Irish Sea, and turned to the south-east over the western Midlands and the southern counties of England, and its centre remained over the British Isles about 34 hours, having traversed about 500 miles. The storm afterwards crossed the English Channel into France, and subsequently again took a course to the north-eastwards, and finally broke up over Holland. In the centre of the storm the barometer fell to 28·5 inches; but, as far as the action of the barometer was concerned, the principal feature of importance was the length of time that the readings remained low. At Geldeston, not far from Lowestoft, the mercury was below 29 inches for 50 hours, and at Greenwich it was similarly low for 40 hours. The highest recorded hourly velocity of the wind was 78 miles, from north-west, at Scilly on the morning of the 16th; but, on due allowance being made for the squally character of the gale, it is estimated that in the squalls the velocity reached for a minute or so the hourly rate of about 120 miles, which is equivalent to a pressure of about 70 lbs. on the square foot. On the mainland the wind attained a velocity of about 60 miles an hour for a considerable time; but, without question, this velocity would be greatly exceeded in the squalls. In the eastern parts of England the velocity scarcely amounted to 30 miles in the hour. The force of the gale was very prolonged. At Scilly the velocity was above 30 miles an hour for 61 hours, and it was above 60 miles an hour for 19 hours, whilst at Falmouth it was above 30 miles an hour for 52 hours. The erratic course of the storm and its slow rate of travel whilst over the British Islands were attributed to the presence of a barrier of high barometer readings over Northern Europe, and also to the attraction in a westerly direction, owing to the great condensation and heavy rain in the rear of the storm. The rainfall in Ireland, Wales, and the south-west of England was exceptionally heavy. In the neighbourhood of Aberystwith the fall on the 15th was 3·83 inches, and at several stations the amount exceeded 2 inches. Serious floods occurred in many parts of the country. A most terrific sea was also experienced on the western coasts and in the English Channel, and the number of vessels to which casualties occurred on the British coasts during the gale tell their own tale of its violence. The total number of casualties to sailing-vessels and steam-ships was 158, and among these were five sailing- and one steam-ship abandoned, five sailing- and one steam-ship foundered, and forty-two sailing- and two steam-ships stranded. During the gale the life-boats of the Royal National Life-boat Institution were launched fourteen times, and were instrumental in saving thirty-six lives.—The climate of Carlisle, by Mr. T. G. Benn, F.R.Met.Soc. This is a discussion of the observations made at the Carlisle Cemetery. The mean temperature for the twenty-three years (1863–85) was 47°·5; the absolute highest was 95° on July 22, 1873, and the lowest −5°·5 on January 16, 1881. The mean annual rainfall was 29·80 inches; the greatest monthly fall was 7·84 inches in July 1884, and the least 0·30 inches in January 1881. The average number of rainy days was 174.—Results of hourly readings derived from a Redier barograph at Geldeston, Norfolk, during the four years ending February 1886, by Mr. E. T. Dowson, F.R.Met.Soc.—Results of observations taken at Delanasau, Bua, Fiji, during the five years ending December 31, 1885, with a summary of results for ten years previous, by Mr. R. L. Holmes, F.R.Met.Soc.

Anthropological Institute, November 9.—Mr. Francis Galton, F.R.S., President, in the chair.—The election of the following new Members was announced:—G. W. Hambleton, D. F. H. Hervey, W. R. Reid, M.D., R. J. Ryle, M.A., M.B., and W. F. Stanley, F.G.S.—Prof. Flower exhibited some of Dr. Otto Finsch's casts of natives of the Pacific Islands, and made some general remarks on the collection.—A paper by Dr. E. T. Hamy, entitled "An Interpretation of one of the Copan Monuments," was read. In this paper the author traced a resemblance between the symbol found upon a large and regular convex stone at Copan and the Chinese "Tai-Ki," and argued that the presence of such a symbol in the ruins of Copan, where there exist so many manifestations of a strange and curious art so closely allied to the Eastern arts of the Old World, furnishes a fresh proof in support of the theory of an Asiatic influence over American civilisation.—An exhaustive paper by Mr. H. Ling Roth, on the aborigines of Hispaniola, was read.

SYDNEY

Linnean Society of New South Wales, September 29.—Prof. W. J. Stephens, M.A., F.G.S., President, in the chair.—The following papers were read:—A revision of the Staphylinidæ of Australia, part ii., by A. Sidney Olliff, F.E.S., Assistant Zoologist, Australian Museum. This part, containing the members of the sub-family, *Tachyporinæ*, is another contribution to a general revision of the family. No marked Australian forms have been found, and the new forms are of the ordinary type. The genera *Tachyporus*, *Tachinus*, and *Bolitobius*, are added to the Australian fauna. With this instalment is issued the plate (vii.), which would have accompanied the first part, but for an unfortunate accident to the artist.—Notes on the bacteriological examination of water from the Sydney supply, No. I., by Dr. Oscar Katz.—On a remarkable Bacterium (Streptococcus) from wheat-ensilage, by Dr. Oscar Katz. This paper contains a brief description of a Micrococcus (Streptococcus), obtained from a sample of mouldy wheat-ensilage which, some time ago, it will be remembered, came under public notice in connection with an epidemic which attacked some horses at Coonong, N.S.W. This micro-organism shows characteristic features in its pure cultivations on or in different nutrient soils. Inoculations of this and other microbes found in the samples are intended to be made shortly upon living animals.—Notes on *Lindsea trichomanoides* and *Eriostemon Crowei*, by the Rev. W. W. Woolls, M.A., Ph.D. Dr. Woolls makes some remarks on the first of these, a fern common in New Zealand, but not recognised until of late in New South Wales. He also exhibited a specimen of *Crowea exalata* (*E. Crowei*, v. M.) from the Currajong, and showing marked differences from the *C. saligna* of the flora. Mr. Bettche, however, of the Botanic Gardens, had collected a specimen which was distinctly intermediate, and which probably may unite the two species, *E. salignus* and *E. exalatus* again, according to the Baron's first determination.—Note on a Labyrinthodont fossil from Cockatoo Island, by Prof. Stephens, M.A. The President read a notice of a fossil Labyrinthodont, probably *Mastodonsaurus* sp., recently found at Cockatoo Island, and pointed out the conclusions to which this fossil, the *Ceratodus* of Queensland, and the *Hatteria* of New Zealand, lead in regard to the ancient geographical conditions of the southern hemisphere.—Notes on Australian earthworms, part ii., by J. J. Fletcher, M.A. In this paper descriptions are given of nine new species of earthworms, of which five are indigenous to New South Wales, one is supposed to have been introduced from the Mauritius, two are from Queensland, and one is from Darnley Island, Torres Straits. They include a new species of Perrier's genus *Digaster*, a new species of *Cryptodrilus*, and seven species of *Perichæta*. The last-named are separable into two well-marked groups: the one characterised by the possession of complete circles of setæ, and by the presence of two cæcal appendages of the large intestine in segment xxvi.; the other characterised by having incomplete circles of setæ, and no intestinal cæca. To the first group belong the species from North Queensland and Darnley Island; and the introduced species. Remarks are also made upon a few worms from Percy Island, which were collected during the Chevert Expedition, and which are now in the Macleay Museum, but are immature or not sufficiently numerous to admit of satisfactory description.—Notes

on some New South Wales fishes, by Dr. Ramsay, F.R.S.E., and J. Douglas-Ogilby. The common Jew Fish of Port Jackson is here described under the name of *Sciæna neglecta*, the authors pointing out the marked differences between it and *S. antarctica*, Castelnau, and *S. aquila*, Lacep., the species to which it has been hitherto referred. Evidence is also given that *Callionymus reevesii*, Rich., is not, as has been stated, the female of *C. curvicornis*, C. and V.

PARIS

Academy of Sciences, November 15.—M. Jurien de la Gravière, President, in the chair.—Letters having been read from M. de Freycinet announcing the death of M. Paul Bert, Resident-General in Annam and Tonquin, and Member of the Academy, the President and M. Vulpian followed with some remarks on the great services rendered to science by this distinguished physiologist. Reference was made more especially to his researches on the action of light on living organisms; on the physiology of respiration; and on the influence exercised on man, animals, plants, and ferments, by increased or diminished pressure of atmospheric air, of carbonic acid, and of oxygen.—Observations of the small planets made with the large meridian instrument of the Paris Observatory during the second quarter of the year 1886, communicated by M. Mouchez. Numerous observations made by M. P. Puiseux on Pallas, Juno, Olympia, Electra, Urania, Europa, and several other minor planets, are here brought into relation with the ephemerides either of the *Nautical Almanac*, the *Bulletin Astronomique*, or the Berlin *Jahrbuch*.—Researches on the phosphates, by M. Berthelot. Fresh researches are here reported on the double decompositions which reveal in the insoluble tribasic phosphates the existence of two distinct states: one colloidal, amorphous, unstable, answering to the manifold constitution of the soluble phosphates; the other crystallised and stable, in which the three basic equivalents seem on the contrary to play the same part. The phosphates of soda, magnesia, baryta, lime, manganese, and the tribasic phosphates of strontian are specially considered.—Observations of Winnecke's comet, by M. L. Cruls. As observed during last September at the Observatory of Rio de Janeiro, this comet presented the appearance of a nebulosity about 2′ in diameter, without clearly-defined nucleus, of somewhat circular form and slight luminous intensity.—Note on Abel's theorem, by M. G. Humbert.—On the flow of a gas penetrating into a receptacle of limited capacity, by M. Hugoniot. The question here dealt with is to determine the time required to fill a receptacle containing air at an initial pressure p_0, and placed in communication with a reservoir maintained by compressing-engines at a constant pressure $p_1 > p_0$. The reading of the paper was followed by some remarks by M. Haton de la Goupillière on this fresh confirmation of his own theories on the flow of gases.—On the variation of the magnetic field produced by an electromagnet, by M. Leduc. Reference is made to M. Marcel Deprez's communication of October 26, which partly confirmed the conclusions already arrived at by the author, and announced to the Société de Physique on February 19, 1886. But the results obtained present considerable numerical differences, which may be due to the different conditions under which the experiments were made.—On the specific inductive power and conductivity of dielectrics: relation between conductivity and absorbing power, by M. J. Curie.—On the velocity of dissociation, by M. H. Lescœur. It is shown that the results drawn from the velocity of dissociation may supply valuable data regarding the presence of the hydrates and analogous compounds; but they can give no absolute or relative indications respecting the tensions of dissociation.—On some laws of chemical combination, by MM. de Landero and Raoul Prieto. In these studies, of which a few preliminary essays are here communicated, chemical combination is regarded as resulting from the shock of a collision between the particles of the elements forming any given compound. The velocity of the particles in motion being considered as a characteristic constant of each body, the loss of energy or of vital force due to the shock between non-elastic particles is regarded as the equivalent of the quantity of heat liberated by the fusion.—On some histological peculiarities of the acephalous mollusks, by M. Louis Roule.—On the typical nervous system of the ctenobranch mollusks, by M. E. L. Bouvier.—On platyrhinism in a group of African apes, by M. A. T. de Rochebrune. It is shown that the family of the Colobi forms a marked exception to the general rule that the apes of the Old World are all catarhinous. As already anticipated by Dahlbom and Gray, they prove to be distinctly platyrhinous, like all the American Simiæ.—Experimental researches on the synthesis of the lichens in a medium destitute of germs, by M. Gaston Bonnier. The researches carried out by the author since 1882 have resulted in the complete reproduction by synthesis of a certain number of species of lichens under conditions fully confirming the views generally held regarding the complex nature of these vegetable organisms. The results clearly show that a lichen is formed by the association of an Alga and a fungus.—The avifauna of the Mentone caves, by M. Émile Rivière. Of the forty-two species found in these caves, all still survive except *Pyrrhocorax primigenius*, but their present distribution mostly differs from that of Quaternary times, many having disappeared from the Mentone district, owing to climatic changes, the destruction of forests, and the chase.—On the Jurassic Echinidæ of Lorraine, by M. G. Cotteau. The researches made by the author in this branch of palæontology show that in Lorraine the Echinidæ followed the same line of development as in other Jurassic regions.—A physiological study of the respiratory function in singers, by M. Anatole Piltan. Observations made in various institutes show that the quality of the voice is inherent to the expiratory type adopted by the subject, whether unconsciously or acquired by special training.—Bacteriological studies on the Arthropods, by M. Balbiani.

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